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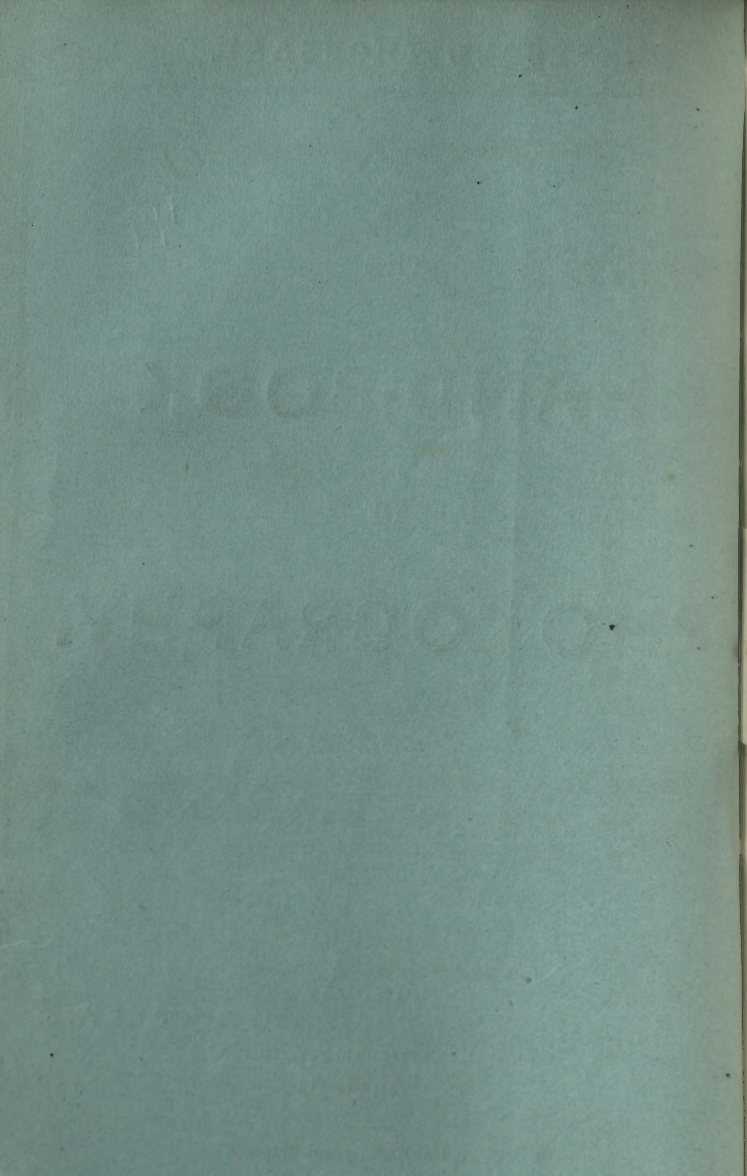
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THE
HAND-BOOK
OF
PHOTOGRAPHY.

SECOND EDITION.

LONDON:
PUBLISHED BY CHARLES W. COLLINS,
ROYAL POLYTECHNIC INSTITUTION.
1853.

Price One Shilling and Sixpence.



SECOND THOUSAND.

THE

HAND-BOOK OF PHOTOGRAPHY,

ILLUSTRATING THE PROCESS OF

PRODUCING PICTURES BY THE CHEMICAL

INFLUENCE OF LIGHT

ON

Much useful matter has been gathered together ;—and at the present time, when photography is a fashion, this little treatise will prove, to the amateur, of some value in directing his earlier steps in the art.—*Athenæum*, March 4th, 1854.

CONTAINING FULL INSTRUCTIONS FOR THE PREPARATION
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OTHER SUBSTANCES EMPLOYED.

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Nov. 20. 1841.

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SILVER, GLASS, PAPER, AND OTHER SURFACES:

TO WHICH IS ADDED

AN APPENDIX,

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Printed by REYNELL and WEIGHT,
Little Pulteney street.

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LONDON:

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ROYAL SOCIETY OF PHOTOGRAPHY.

1853.

P R E F A C E.

THE following pages have been written, not with any pretensions to the claim of originality, or in the way of discovery, but simply for those who are desirous of prosecuting this highly interesting and beautiful study, and who may require a condensed yet sufficiently comprehensive hand-book to enable them to conduct the several processes step by step. The object of this little treatise will accordingly be answered if the disappointments, which so frequently beset the path of the beginner in any new branch of investigation, are, by its means, prevented; or at least so far softened down that, with moderate care and attention, success in the several branches of the art may thus be brought within the reach of those who may wish to practise Photography without the assistance of an instructor.

The author has refrained, except in some few cases, from introducing the names of the very many experimentalists who have recommended this or that preparation, though not, be it observed, with any desire to appropriate to himself their labours and discoveries. At the end of the volume will be found a "Summary of the History of Photography," arranged by Mr R. Hunt, and extracted from the 'Journal of the Photographic Society,' page 29, in which the claim of each discoverer seems to

be very fairly set forth. Here and there changes have been made in quantities, which long experience has led the author to consider better adapted than those given in other works upon the same subject. At the same time the addition of the Appendix will, he hopes, be found of much use to the young Photographer, containing, as it does, the chemistry of all the various materials he is called upon to employ, and explaining not only their chemical composition and mode of preparation, but pointing out how and for what they are to be employed when not otherwise expressed in the body of the work.

The only claim he makes is to simplicity of diction and conciseness of style in describing the processes of this somewhat complicated though beautiful art, in order that the amateur may be enabled to practise them with as little difficulty as possible.

London, June, 1853.

P R E F A C E

TO

THE SECOND EDITION.

THE very favourable reception this little Manual has received at the hands of the public, the First Edition of 1,000 copies having been sold off in a little less than eight weeks after its publication, has led to an immediate issue of the Second Thousand.

The present Edition has been most carefully revised by the Author, some few errors corrected, and much additional matter added.

August, 1853.

PREFACE

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August, 1853.

HAND-BOOK, &c.

PHOTOGRAPHY IS NATURALLY DIVIDED INTO
THREE DISTINCT PROCESSES, *viz.* :

1. Daguerreotype on silver plates.
2. Collodion and albumen on glass.
3. Talbotype on paper.

Although these (especially the two latter) admit of many variations, yet under these divisions of the subject may be included all that is interesting and useful to the practical Photographer; and as the present work is not intended as an elaborate treatise upon the subject, it is not the intention of the author to display extensive reading by crowding into these pages quotations from the many valuable works of the day upon light and optics.

The study of these subjects will be left to the discretion of the reader, who would do better to acquire such knowledge as he requires from the original sources, rather than from the garbled extracts with which works upon this subject are but too frequently filled.

PROCESS No. I.

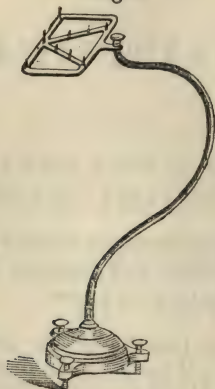
DAGUERRETYPE.

The Daguerreotype has, from first to last, six different stages or operations, each of which being of equal importance, the neglect of any one is fatal to the whole. They are usually given as follows: 1. Cleaning the silver plate. 2. Charging it with the sensitive mixture. 3. The camera. 4. Mercurialization. 5. Washing. 6. Fixing. These we shall now describe in their order.

OPERATION I.

CLEANING THE PLATES.

Fig. 1



The plates which are employed are made of thin sheet copper, silvered on one side, and commonly called Sheffield plate.

The author almost invariably uses the French plates No. 30, which he finds to answer admirably, the coating containing enough silver to permit of their being cleaned several times without damage. The plate being placed on a sheet of cartridge or other stiff paper, with the copper surface downwards, the operator should take a small tuft of cotton formed into a kind of pledget, charge it with a drop or two of olive oil, and then dipping it into tripoli powder,* clean the silver surface with it, changing the cotton with the oil and tripoli two or three times, as occasion may require. The pressure of the pledget should not be either hard or violent, but yet sufficiently firm to give the plate a uniform dull appearance; then, with a fresh piece of cotton dipped into a fresh charge of tripoli, clean off the oil. It will be found more convenient to have the various polishing and cleaning powders, viz.,

* It is of the utmost importance that the materials employed in cleaning the plate should be kept distinct, even to the pieces of paper on which it rests.

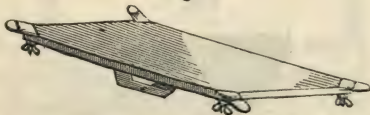
two of tripoli, one of rouge, and one of lamp black (the use of which will be hereafter mentioned), tied up in fine lawn bags, and kept in boxes marked Nos. 1, 2, 3, and 4; when required for use, by gently tapping, not dabbing, the bag over the plate, a sufficient quantity of the powder is sifted out.

The plate, now cleansed* of its oil, is to be placed upon the stand, Fig. 1, with the silver side uppermost, and the flame of the spirit lamp passed across the under surface until the silver assumes a slight but uniform opacity.

Care should be taken not to overheat the plate. When the opacity before mentioned is obtained, remove the plate by gently sliding it off, or by applying a pair of pliers to one of the corners, on to any good conducting surface (a slab of cast iron for instance), and let it remain there until it is quite cold. The burning, as this is called, is for the purpose of removing all traces of the oil from the interstices of the plate. Some operators recommend the use of spirits of wine or essential oils instead of the olive oil, and then dispense with the burning. My own experience induces me to give the preference to the burning, whatever may be the material employed in cleaning, particularly with plates that have been used.

The plate, when cold, must undergo the process technically called buffing. In doing this it may be held in the hand if small, or if large, it should be attached to the buffing frame. The buffer is a flat

Fig. 2.



piece of deal or mahogany, about three inches wide, from twelve to sixteen long, and half an inch thick, and covered first with flannel or wash leather strained tightly

* In the original process of Daguerre, dilute nitric acid, viz., one of acid to sixteen of water, was recommended to be employed after the removal of the oil with pledgets of cotton, but this is seldom used by Photographers now.

over it, and afterwards with cotton velvet or stout buff leather (see Figures). At least three of these buffers should be provided, and marked Nos. 1, 2, and 3; and after use,

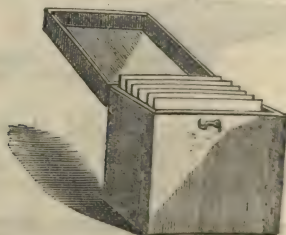


it is as well to put them into a kind of paper sheath, taking care never to substitute the one for the other.

The plate, when fixed to the buffing frame, is to be held in the left hand, and some tripoli from No. 2 bag sifted over the buffer No. 1. Then, by a brisk rubbing motion, apply the buffer to the surface of the plate until the opacity is replaced by a brilliant black polish. In this and all the subsequent buffings it is advisable to buff always in the same direction, *i. e.* either in the direction of the length or of the breadth of the plate.* Without removing the plate from the buffing frame, the buffer No. 2 may now be employed exactly as we have above directed, using the bag of rouge No. 3 as the polishing powder.

The plate is now cleaned and polished, and if not required for immediate use may be placed in the plate box, as shown in the cut: but before using it, either

Fig. 3.



* For portraits, the buff should be used across, and for landscapes, &c., in the direction of the length.

now or at a subsequent period, a final buffing must be given to it, the process of which is the same as before described, only substituting buffer No. 3 and the prepared lampblack No. 4 bag.

OPERATION II.

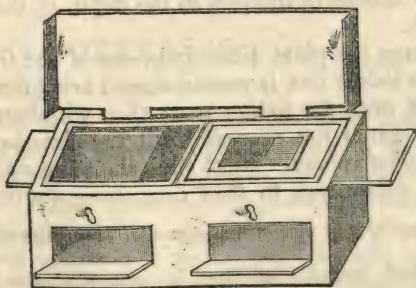
CHARGING WITH THE SENSITIVE MIXTURE.

The plate, now cleaned, polished, and buffed, is next to be exposed to the sensitive process.

In the original plan of Daguerre this consisted merely in subjecting the plate to the vapour of iodine. The latter, although still retained, is greatly assisted, both as regards time and effect, by what is commonly called the accelerating mixture.

Various mixtures have been proposed by different Photographers, all of which consist either of iodine and bromine, iodine and chlorine, bromine and chlorine, bromine and water, or bromide of lime of Mr Bingham. The latter compound is the one invariably used by the author, and its advantages over every fluid accelerator justifies him in strongly recommending it, at least to all young experimentalists.

Fig. 4.



The cut is a drawing of the apparatus called the iodine box, which is of an oblong shape, the size being adapted

to the largest plate the camera will take. In this box are two deep glass pans, the edges of which are ground, so that by the action of a spring placed at the bottom of the box the pans are made to fit up close against two plates of thick glass, which serve as sliding covers to the volatile contents. In the front of the box are two small doors furnished with pieces of looking-glass, immediately opposite to which, on the other side of the box, are two corresponding holes. This appendage is for viewing the plate during the process of coating it with the sensitive mixture.

The iodine and bromine box, when in use, is so placed in a room moderately darkened that the holes opposite the doors, before described, may receive through any convenient aperture a beam of subdued daylight, or the light of a candle, whereby the surface of the plate being reflected on to the looking-glass in the doors, the operator is enabled to observe the changes of colour produced without removing the plate each time for inspection. After a very little practice the operator is enabled by experience to judge as to the time necessary for the exposure of the plate without any of the contrivances which have been described. In charging the box, a few crystals of iodine must be placed in one of the pans,* and in the other the bromide of lime†, in quantity sufficient to cover the bottom of the pan to the depth of the sixteenth of an inch.

To charge the plate, place it in one of the frames with which the iodine box is provided, and bring the plate and frame first over the iodine pan; then withdraw the glass slide, and watch the process until the plate has received a deep golden colour. Next slide the plate and its frame from the iodine pan to that containing the bromide of

* It is not by any means necessary to cover the whole of the surface.

† The fresh bromide of lime is generally of a bright red colour, but after several days' use, in consequence of the loss of bromine, it becomes fainter and fainter in colour, and at last perfectly white. When any very perceptible change of colour has taken place, a fresh supply must be given.

lime, and having withdrawn the cover, watch the plate until the colour changes to a deep brown; when this is obtained, slide the frame and plate back again over the iodine pan, and allow the iodine vapour to act upon it until it begins to assume a rose tint; the moment this is observed shut up the iodine pan, and the charging of the plate with the sensitive mixture is completed. It is quite impossible to give any direction with reference to the time of exposing the plate to the iodine and then to the bromide, as this will vary from thirty seconds to two minutes, owing to many different causes which operate to retard or facilitate this part of the process, such as the quantity and freshness of the accelerating mixture, the size of the plate, and the temperature of the room. For a plate $2\frac{3}{4}$ by $3\frac{1}{4}$ inches, when the temperature is about 50° , I generally find that forty-five seconds for the iodine, thirty seconds for the bromide, and then thirty seconds for the second iodine seldom fail; a different temperature, and a larger or smaller plate, will require either a longer or a shorter time, as experience and practice can alone determine.

One frequent source of failure, affording much trouble and annoyance, is a damp room; it is never desirable to have the operating room too warm, but it cannot be too dry.

OPERATION III.

THE CAMERA.

Much has been written upon the best form of this instrument, but whatever arrangement the taste of the maker or the whim of the operator may suggest, it is of comparatively little moment compared with the importance of having a good lens.

As before remarked, it is not our province to enlarge upon the optical construction of this important part of the apparatus of the Photographer. The reader had much better rely upon the respectability of the maker from whom he purchases it, unless his optical knowledge is

such as to enable him to judge for himself. The foreign lenses are by many most esteemed, although those now made in England are of beautiful quality, and capable of producing very excellent pictures.

Fig. 5.



One of the most common forms of the Photographic camera is shown as above. When required for use, the tripod support, with its camera attached, should be arranged previously to the final steps being taken in the preparation of the plate. If the picture to be produced is a landscape, or a group of still life, little more is necessary than taking the precaution to fix the camera in a line parallel with the base of the view, or of the objects arranged. It is a great mistake to suppose that a bright sunshine produces the best effect ; on the contrary, the

result is frequently most inharmonious: violent contrasts should always be avoided, but in taking a portrait, much more care and attention is required, the neglect of which, together with absence of artistic feeling, are the main reasons why so many of the Photographic portraits are little more than mere caricatures of the originals.

The camera is not unfrequently fixed by the unskilful upon an immovable table or pedestal, and the sitter allowed to place himself in any attitude, the consequence of which is, that his head, eyes, arms, and legs are so often in a forced position; and to crown the whole, the camera may be so arranged, either above or below the medium line, that the upper or lower portion of the body is thrown out of focus, or very much distorted. It is almost impossible to give any verbal directions on this head; it must be left to the taste and skill of the operator. It is always advisable, where possible, to have the face so situated as to be in a line with the axis of the lens, as there the least amount of distortion will be produced.

The camera being adjusted in reference to position has now to be focused. In doing this, the operator envelopes his head and the back of the camera in any dark substance, such as a piece of black calico, which enables him to exclude the light from the ground glass, and to bring out the image with the greatest precision. It is well in focusing to make the first adjustment by placing the lens midway, *i. e.*, so as to stand one half out of the sliding tube. Then draw in or out the sliding box of the camera, with its ground glass attached, until the picture appears to be as perfect as this part of the arrangement will permit, and let the final focus be secured by turning the nut of the lens.

It is now generally considered that the rays of light forming the visible picture on the ground glass of the camera have but little to do with the chemical changes produced upon the photogenic surface by which the picture is eventually produced. A set of rays (until recently thought to be invisible) which accompany the

former, and which have received the name of actinic, are regarded as being the sole cause of the chemical effect produced upon the prepared surface. Now the focus, or point of convergence, of these rays does not coincide with that of the luminous rays which convey to the eye the picture on the ground glass of the camera. Hence it follows that a want of coincidence must necessarily lead to a want of true definition in the picture, when the operator is guided only by the luminous image in focusing his camera. And this in practice is found to be the case. Fortunately, however, the difference is not such as to render the latter mode of adjusting the camera entirely abortive, although there can be no question that the actinic, and not the luminous, focus is that at which the plate or paper should be placed.

No information can be given here as to the actual difference between the two foci, as they will vary with every lens; but in most cases it will be less than the visual focus, when no correction has been made to combine the two sets of rays in one.

This, however, has been carried out with considerable success by both English and foreign opticians, but a good compound lens, in which such a coincidence is fully effected, is an article far too expensive for many who follow Photography only as an amusement.

In a work so purely elementary as the present, it would be out of place to attempt any illustration of this rather abstruse point. A very simple mode, however, may be employed, which will only require a few experiments to place the operator in possession of the distance to which the lens must be moved after having made the visual focus. This distance being once determined, will be found to vary only in a very slight degree, under whatever circumstance the camera may be placed.

In taking what is called a stereoscopic picture, with only one camera, the two plates should be prepared at the same time, to avoid delay as much as possible.

The board of the tripod-stand on which the camera is

screwed may have described upon it an arc of 90° ,* divided at every fifth degree. A mark should then be made at the end of the camera, coincident with the centre of the lens, which mark for the first picture should be in a line with the zero of the graduated quadrant.† In this position the first picture is to be taken; then, for the second, move the camera either to the right or left, from 10° to 20° (according to the distance from the object), as marked by the line at the back of the camera, &c. When two cameras are employed having lenses of the same focal length, it is only necessary so to place them that the difference between the parallelism of the two inner sides of the cameras shall include a corresponding arc to that given above, viz., 10° to 20° , according to the distance of the object. In taking stereoscopic views of distant objects, if the following simple rules are attended to, results of the most startling effect may be produced. If the nearest object is distant fifty feet from the cameras, then place the latter two feet asunder; if 100 feet distant, then separate them to a distance of four feet, and so on in that proportion, taking great care to preserve the cameras in an horizontal position, which is best done by the aid of a spirit-level.

The operator having given to the plate its last buffing with the prepared lampblack (see process 1), and its sensitive coating (process 2), must remove it by the thumb and finger from the iodine box, and place it in one of the frames belonging to the camera. Great care must be taken not to allow any light to fall upon the surface of the plate until it is finally placed in its position in the camera, to effect which, draw out the slide with the ground glass from the back of the camera, and substitute the frame containing the plate. The dark stop of the lens being closed, draw up, or out, the opaque screen

* This may be laid down on a piece of stiff card-board, and applied to the stand as occasion may require.

† If no provision is made to measure the angular distance, then, after taking the first picture, the camera should be moved over a space equal to about one-fifth of the distance of the former from the object to be copied.

in front of the plate, and then remove the stop from the front of the lens. The light reflected from the object to be copied now passes through the lens or lenses, producing on the plate those changes which prepare it for the fourth process, by which the picture is developed. As regards the time of exposure in the camera, no definite duration can be given that will be found to answer on two consecutive days, or even hours, though the means employed be the same on both occasions.

The following are some of the principal causes operating to render this part of the process always uncertain:—

- 1st. The size of the lens and its construction.
- 2nd. The degree of sensibility of the plate.
- 3rd. The time of the day and state of the atmosphere.
- 4th. The nature of the object in reference to its power of reflecting light.
- 5th. The situation, whether in-doors or exposed to the open air.

6th. Whether the object is illuminated by a side light, as at a window, or from a downward light, as from the sky-lit room. These, and several other causes, will at once show how impossible it is to give any fixed direction, as regards time, in this part of the process. But let not the young operator be disheartened by the thought that the difficulties of the undertaking are insurmountable. A very little practice, patiently persevered in, will give an amount of exact knowledge and skill which further explanation will not afford.

If the plate has been properly prepared, and the day at all favourable, from five to thirty seconds is generally the range of time required.

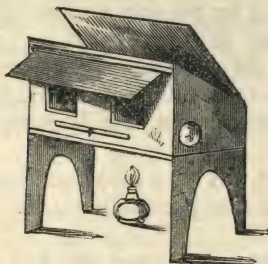
It frequently happens, that in order to bring out the dress fully, the face is, to use the technical term, solarized. To avoid this, the operator should be provided with a piece of black cloth attached to the end of a stick of about a yard in length, which may be held before the face and lighter parts of the dress, while a few more seconds can be given to the darker portions, which are by this means brought out with greater effect.

When the proper time has been given, the opaque slide of the camera is to be returned to its original position, and the frame and plate withdrawn, but without moving the camera, that it may be ready for the repetition of the process, if necessary. The plate in the frame is now brought into the darkened room, and is ready to undergo

OPERATION IV.

MERCURIALIZATION.

Fig. 6 is a drawing of one of the most usual forms of
Fig. 6.



the mercury box. It is generally made of mahogany, the bottom being constructed of thin sheet-iron, with the centre beaten out so as to form a kind of basin for holding the mercury, into the middle of which the bulb of a thermometer is inserted, whose scale is attached to the outside of the box. To prepare the mercury-box for use (which of course must always be employed in the dark operating room) pour the mercury* through an extemporaneous funnel, made of a piece of paper, in quantity sufficient to touch the bulb of the thermometer. The plate, removed from its frame by the finger and thumb (touching the extreme edges only), is now to be placed in a

* The mercury should be quite pure, so that when poured into the pan the surface remains perfectly bright.

corresponding frame, with which the mercury-box is provided, and forthwith slipped into the slide made in the box to receive it. A lighted spirit-lamp is next applied to the basin holding the mercury, and the action of the heat continued until the temperature reaches about 150° to 180° Fahrenheit, when the flame must be withdrawn.

It is not well to have too large a flame to the lamp, because the more gradually the elevation of temperature is produced the more perfect generally is the picture. The plate may now be left in the box for ten, fifteen, or twenty minutes, or until the mercury is cooled down nearly to the temperature of the surrounding atmosphere.

For the purpose of ascertaining the progress of this part of the process, the slide in front of the box may be withdrawn, and by placing a taper at the little glass window the state of the deposit of mercury in its development of the picture may be readily seen. As soon as the picture is fully developed, the plate with its frame should be withdrawn, and is ready to undergo the next process.

Various defects will often manifest themselves here:

1st. The picture may not show itself at all, or be very faint.

2nd. The picture may come out, but all the finer gradations of light and shade be lost.

3rd. It may present a kind of semi-opaque haziness.

4th. Only part of the picture may be developed.

5th. Spots or blemishes may show themselves; and,

6th. The picture, although good in other respects, may be blurred in the outline.

It is much easier to point out the defects above-mentioned than to give explanations of the causes so as to prevent their repetition; they are, however, such as every experimentalist must expect to find at the outset of his career as a Photographer, unless he happens to be more fortunate than others. Without attempting to define the exact cause that may have produced any of these, we will here offer such suggestions as our own experience enables us to give.

1st. Want of time in the camera, or the dulness of the day.*

2nd. An improperly cleaned plate; or,

3rd. Some defect in the iodizing, or more probably in the accelerating mixture.

But as it is impossible to say which of these may be the cause (experiment only can determine), take another plate, prepared exactly as the last, and give it double the time allowed to the former in the camera. Should the result be the same, then probably the accelerating mixture is at fault. Should the plate present only part of the picture, it is almost certain that the fault rests with the plate.

2nd. The picture may be produced, but all the fine gradations of light and shade be lost. This defect frequently arises from too long an exposure in the camera, by which the plate becomes solarized, and in consequence the mercury is deposited with equal intensity over every part of the picture.

3rd. The picture may present a kind of semi-opaque haziness; this may arise from over-mercurializing it, *i. e.*, from giving to the mercury too high a temperature. It is advisable not to push the temperature beyond 160° . Many Daguerreotypists, I am aware, sometimes raise it much higher than this, but this involves the necessity of greater care and attention, or the picture will be spoilt.

4th. Only part of the picture is developed, say one-half or two-thirds; this is generally caused by not drawing out to the full the sliding-glass cover of the iodine or accelerating frame, and is therefore easily obviated.

5th. Spots and blemishes may show themselves: dust is frequently the principal cause of this defect, to avoid which great care should be taken to remove every trace of it from the frames of the camera and of the iodine-box, as

* It is to be observed that there are many days in this country which, though according to ordinary phraseology they would be called bright, are in every sense unfitted for Photography, more particularly those which give a yellowish hue to all surrounding objects.

also any minute globules of mercury that, by use, may attach themselves to the frame of the mercury-box.

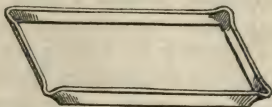
6th. The picture, although good in other respects, may be blurred in the outline; this may arise from a movement of either the object or the camera during the time the picture is being taken. If it be a portrait, in nine cases out of ten this may be attributed to the sitter, but it frequently happens that in the case of views taken out of doors the camera is not placed on a firm support, so that the slightest change of position frequently doubles the outline.

OPERATION V.

REMOVAL OF THE SENSITIVE SURFACE.

For the removal of the sensitive coating from the surface of the plate, or, as it sometimes called, washing, three shallow earthenware pans or dishes are necessary ;

Fig. 7.



into one of these should be poured common water from the domestic supply, into the second a solution formed by dissolving half an ounce of hypo-sulphite of soda (see Appendix) in half a pint of water, and into the third distilled water. The plate is first to be placed in pan No. 1 with the common water ; after remaining in this for a few minutes it is to be transferred (by the thumb and finger applied to the edges only) to No. 2, containing the hypo-sulphite, by the action of which the compound of iodine and bromine is dissolved from the plate. When

* It is not necessary that this should be done immediately ; it is generally more convenient to put it into the plate-box, so that the result of the day's work, or of two or three days, may be washed at one time. It is desirable, however, not to expose the plates to the daylight oftener than is absolutely necessary.

this is effected (which will be known by the rose colour of the plate disappearing) it must be returned to pan No. 1, and then transferred to pan 3, with the distilled water.

Finally, remove the plate from the latter and pour over its surface some boiling distilled water, holding the plate in an inclined position. The heat communicated to the plate by the water causes it to dry with rapidity, which may also be increased by gently blowing upon the surface with a small pair of bellows or the mouth. Considerable care is necessary in the management while the plate is still hot from the water, since, if drops of water are permitted to dry on it, even with the best distilled water, they are almost sure to produce stains. In the foregoing pages we have endeavoured to convey, with as little circumlocution as possible, those instructions in this part of Photography, the observance of which we have found to answer in the production of what are commonly called, by way of distinction, Daguerreotypes. Two other processes remain to be described, which, however, are not essentially necessary for the production of the picture, although, when judiciously employed, they add much to its interest and effect.

OPERATION VI.

FIXING THE PICTURE.

The mixture employed in this operation is a solution of gold in hypo-sulphite of soda (see Appendix), and the object to be gained is the bringing out of the lights and shadows with greater force and brilliancy.* This process, although simple in the description, requires much care and practical skill in the management.

The plate, after removal from the trough No. 3, should be well washed by letting fall upon it cold distilled water,

* As a coating of gold is thus formed upon the plate, unless the picture is intended to be preserved it is not only wasting time to fix it, but the gold surface renders it more difficult to prepare the plate for a subsequent picture.

and while still moist, must be placed on the stand, Fig. 1. which, by the aid of the three screws in the base, has been previously placed in a truly level position. In this condition the solution of gold is poured upon the surface of the plate, taking care that only so much is employed as to prevent its overflowing the sides. The spirit-lamp is then cautiously passed under the plate until its surface becomes covered with minute bubbles, when the flame must be withdrawn, and after a few minutes the bubbles will subside. The picture then assumes a stronger tone, *i. e.*, the shaded portions are deepened and the lights heightened in proportion. The gold solution may now be poured off, and the plate washed with the boiling distilled water, as before directed.

OPERATION VII.

COLOURING.

The colouring of the Daguerreotype is an addition which requires not only the skill, taste, and judgment of an artist, but also a peculiar mode of treatment which can be acquired only by practice. The colours* are used in the dry state, and are applied to the surface of the plate by taking up a very small quantity on a fine camel-hair pencil, and dusting it, as it were, upon the surface, then blowing off the superfluous colour with a small Indian-rubber bottle, and slightly breathing upon the surface. An increased depth of colour can be produced by repeated applications of the same means. The colours commonly employed are ultramarine, carmine, and chrome yellow; by a judicious combination of these three, almost any required tint may be obtained. For gold and silver, compounds sold by the artists' colourmen under the name of shell gold, &c., may be employed.

* The colours are ground to an impalpable powder, and mixed with dry gum or starch.

PHOTOGRAPHY ON GLASS.

DIVISION No. II.

COLLODION PROCESS.

The preparations necessary for taking pictures by this process may be divided into seven operations, or, including the making and iodizing of the collodion, eight. (See Appendix. Article Collodion.)

The seven operations are:

- 1st. Cleaning the plate;
- 2nd. Coating it with a film of collodion;
- 3rd. Charging it with nitrate of silver;
- 4th. Exposure in the camera;
- 5th and 6th. The development of the negative or of the positive picture; and
- 7th. The fixing.

OPERATION I.

CLEANING THE PLATE.

The plates used in this process are thin flatted crown glass, cut to the required size, and slightly ground at the edges. The margin of the plate should be roughened, by which a firmer hold of the collodion film is obtained. The cleaning of the plate for the collodion is much less complicated than that before described for the Daguerreotype; it requires, however, equal care, for the least film of grease, even though imperceptible, or the attachment of any dust that may be floating in the room, is fatal to the production of a perfect picture.

For cleaning the plates, the operator should have two clean and dry linen towels, perfectly free from the soap employed in their washing (old towels so washed are preferable to new ones), a large soft chamois leather,* and a small bottle of ammonia. Though many different modes have been employed in this operation, I find the following to be all that is practically necessary. Pour upon one surface of the plate of glass a few drops of ammonia,† and rub it with a pledget of clean cotton; then place the plate under some clean running water, as the tap from a small barrel. There is no necessity to employ distilled water. When well washed, dry it with the first cloth, then with the second, and finally with the leather, taking particular care that the fingers do not touch the plate, which is now ready to receive the collodion film.

OPERATION II.

COATING THE GLASS PLATE.

Of the various modes of holding the plate for the reception of the prepared collodion, the following is recommended for its simplicity:—The plate, cleaned as above directed, may be removed from the leather by the operator taking hold of it at one of the corners with his left hand, then, holding it in a horizontal position, let the collodion be poured upon the centre in such a quantity as will, when extended, cover the surface of the plate.

It is always better to have a little excess. Then gently incline the plate so that the collodion may be made to flow over the entire surface, inclining the fluid to one corner. The excess being brought to the corner, hold that over the collodion bottle, and bring the plate into a vertical position, so that the excess of fluid is now got

* This, as supplied by the shops, contains much powdery matter, consequent upon its preparation, to remove which it must be washed in several waters, and when dry must be rubbed soft.

† For the ready detection of the cleaned side I generally make a scratch with a diamond, or an irregular piece of flint.

rid of and the lines which frequently form as the latter moves over the surface gradually coalesce, and form a clear and even layer over the whole.

It must be remembered that the collodion is an ethereal preparation, and therefore quickly evaporates; consequently, in applying it to the plate, no unnecessary delay should be permitted in carrying through the process. Haste, however, should be avoided, except by those to whom practice has given a facility of manipulation. The plate, with its collodion film, may now be allowed to stand for a little time, in order that the ether may be evaporated.

OPERATION III.

CHARGING OR EXCITING THE PLATE.

EXCITING SOLUTIONS.

No. 1.

Crystallized nitrate of silver . .	40 gr.
Distilled water	1 fl. oz.
Alcohol	30 drops

OR,

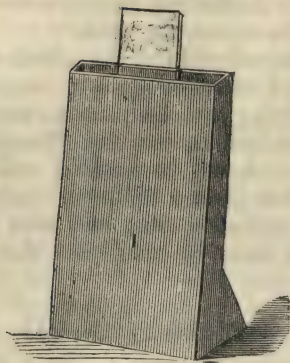
No. 2.

Nitrate of silver (crystallized) .	30 gr.
Distilled water	1 fl. oz.

Filter the solution through white blotting paper. Generally about eight or ten fluid ounces of this solution for the smaller plates* will be found requisite, but this will, of course, depend upon the size of the trough (Fig. 8), in which the plate is to be immersed. It is necessary to observe that this part of the process must, from the extreme sensitiveness which the plate acquires, be conducted in a room from which the light of day has been most carefully excluded, using only the light of a taper, and that at some distance from the operator. The trough having been filled to the proper height with

* This preparation should never be exposed to the day light, which decomposes it. The bottle should be surrounded with black paper or tin foil, and when not wanted for use, should be put away in a dark place.

Fig. 8.



the nitrate of silver solution (which should be quite clear and bright), the plate with its film of collodion is now to be placed on the glass dipper (Fig. 8), and at once passed into the solution, great care being taken to submerge the whole at once, and not to introduce it by degrees, for by this latter mode of immersion lines are almost sure to be formed, and will show themselves in a subsequent part of the process. The plate should now be allowed to remain in the trough for about thirty seconds, then lifted at once bodily out of the solution, and again immersed as before directed. This should be repeated three times, *i. e.*, at the expiration of each minute; but after the third removal, if the temperature is not below 60° , and the plate has lost its greasy appearance, the solution flowing freely over its surface, it may not require another immersion. In that case hold the plate by the glass dipping rod over the trough until all the superfluous moisture is drained off, but by no means allow the surface to become too dry. Then place it in the camera frame, as before directed for the Daguerreotype process. The temperature of the room is of much importance in coating the plate. If possible it should not be lower than 60° ; if so, the solution should be warmed before the fire, or better place the bottle in

warm water heated to 70° or 80° before pouring it into the bath.

The exciting solution, after it has been used, should be filtered and returned to the bottle; a new solution is seldom found to work so well as one that has been in use for some time, the new solution seems frequently to disturb the collodion film. To get rid of this inconvenience in a new solution, it has been recommended to add a few drops of a saturated solution of the iodide of potassium. Allow the whole to stand a few hours, and filter through paper.

OPERATION IV.

EXPOSURE IN THE CAMERA.

The camera being previously adjusted and focused, the plate is now to be treated in the same manner as with the silver plate.

As to the time of exposure no positive directions can be given, but if the collodion plate has been prepared with all due caution, and if experience has given to the operator a facility of manipulation, the time of exposure to the influence of the light is of a much shorter duration than that required for the Daguerreotype process. For instance, in taking a portrait in the open air, on a bright, clear, and warm day, by the Daguerreotype process, ten seconds may be necessary, but with the collodion plate, from three to five, or even less will be found sufficient. By the latter process, viz., the collodion, two different results may be secured, which have been respectively designated positive and negative, the meaning of which we will briefly explain before describing the manner in which they are obtained. In the former, viz., positive, the process, when completed, simply forms one picture; but in the latter, the lights and shades are all reversed, forming what is called a negative picture, from which, however, almost any number of duplicates on paper (which will be positive) may be obtained, as hereafter described.

The plate and its frame being, we will suppose, removed from the camera, and brought back into the dark operating room, is ready for

OPERATION V.

CALLED THE DEVELOPMENT OF THE NEGATIVE IMAGE.

DEVELOPING SOLUTIONS.

No. 1.

Pyrogallie acid	5 gr.
Distilled water	10 fl. oz.
Glacial acetic acid	40 drops

OR,

No. 2.

Pyrogallie acid	6 gr.
Distilled water	8 fl. oz.
Glacial acetic acid	50 drops

OR,

No. 3.

Pyrogallie acid	7 gr.
Distilled water	3 fl. oz.
Glacial acetic acid	2 drachms

The plate, when removed from the frame, shows no indication (if not exposed too long in the camera) of any change resulting from the action of the light. To bring out the picture with the collodion process, the plate must be subjected to the treatment we will now describe. Dissolve the gallic acid in the water, and then add the acetic acid; filter the solution, and keep for use. Solution No. 1 is that employed by the author. Have ready on a firm support the stand, Fig. 1, placed upon a sheet of white paper, and bring it into a perfectly level position by means of the screw; let the glass plate be placed upon it, with the collodion side uppermost.

Into a clean glass measure, or a wine glass, pour out such a quantity of the above mixture as, when transferred to the plate, will cover it entirely without running over the sides, to which add from two to five

drops of a solution of nitrate of silver, made in the proportion of fifty grains of the silver salt to one ounce of distilled water.

Here some little care and dexterity is required, in order to prevent the solution from standing in detached portions upon the surface of the plate. A slight inclination given to the latter with a rotatory movement seldom fails to effect an equal distribution, or the same results may be sometimes obtained more readily by very gently blowing upon the plate at the time of pouring on the fluid. By looking down upon the white paper through the glass plate (the light from the taper being kept below it) the picture will be seen to make its appearance. It is necessary now to watch the process very carefully, so as to obtain a sufficient development without incurring an excess. A good criterion is afforded by the change of colour which the developing fluid undergoes. If not arrested at this point, a deposit is likely to be formed on the plate, which, if it does not entirely destroy the picture, will very much injure the general effect.

The following solution has been recommended as a good developing agent:

Protosulphate of iron	125 gr.
Distilled water	10 fl. oz.
Sulphuric acid	6 drops
Acetic acid	3 drops

This solution, when filtered, may be poured into one of the earthenware pans, and the plate immersed into it; the picture is generally rapidly developed.

It may happen in very warm weather, and when some time has elapsed between the removal of the plate from the camera and the process above described, that the surface of the plate has become nearly dry, in which case it is advisable to give it another dip into the exciting mixture (Operation IV) previous to the development, taking care not to use the fluid which has been already employed in exciting the plate (unless it has been refiltered), but a fresh supply taken from the bottle. Should the picture not develop itself, we may rest satisfied that the exposure

in the camera was not sufficiently long. If, on the contrary, the picture should be produced with so much depth as to destroy all the half-lights, it has been too long in the camera.

Presuming that the development has been carried to the necessary point, the fluid has now to be poured off the plate, and the latter, held in a horizontal position, should be well washed by pouring over it a copious supply of water from any convenient vessel held a short distance above it. It is then ready for

OPERATION VI, OR, FIXING THE PICTURE.

FIXING SOLUTION.

No. 1.

Hypo-sulphite of soda	5 oz.
Distilled water	$\frac{1}{2}$ pint

Dissolve and filter.

The plate, as washed in the last process, is now placed in one of the washing-pans, Fig. 7, and a solution of the hypo-sulphite of soda poured into the trough, which is held in an inclined position, the plate being placed at the upper end. The trough, on being brought into a horizontal position, permits the hypo-sulphite to flow over the plate (daylight may here be employed), when by a gentle inclination to and fro it will be seen that a gradual disappearance of the thin cloud which has hitherto covered the picture, takes place,* or the plate may be placed on stand Fig. 1, and the solution poured over it as directed for developing. After this, the hypo-sulphite is to be poured off the plate, which must again be well washed, by pouring into the trough different

* It may not unfrequently happen that the collodion film, although capable of producing a tolerably good picture, is yet so delicate as not to admit of the floating of the hypo-sulphite over it, as described above. In that case a bath and dipper, as in Operation III (Fig 8), may be employed, in which the fixing process is carried out.

portions of water, and agitating the latter, as described above. Too much attention cannot be paid to the washing, as the slightest trace of the hypo-sulphite, if allowed to remain, would eventually destroy the whole of the picture.

The collodion film is occasionally found to suffer slightly from the action of the hypo-sulphite, to obviate which the following solution has been suggested as a fixing agent; it requires much more care and attention than the former, and would eventually destroy the picture if allowed to remain too long in the solution.

FIXING SOLUTION.

No. 2.

Persulphate of iron 15 gr.
Distilled water 1 pint

Dissolve and filter.

The picture when developed must be well washed in plenty of water, and the above solution poured over it, after which, it should be again well washed, and quickly dried, if necessary, by the application of a gentle heat.

These negative pictures are intended principally for producing positives on paper by what is called transfer, and as the collodion film is extremely delicate, many Photographers coat it over with a layer of varnish. (See Appendix: Amber, Gum Dammer.) The two varnishes commonly employed are mastic dissolved in turpentine, and the pale spirit-varnish of the shops. The former may be applied cold, and poured over the plate exactly in the same manner as in using the collodion. The excess may be returned into the bottle. The plate is then to be placed upon its edge in a dry warm situation free from dust, until the varnish becomes dry and hard. In using the spirit-varnish the plate must be previously warmed, but not made so hot as to cause too rapid an evaporation of the spirit. This varnish is applied as the former, but when it is evenly spread over the surface the plate may be placed in the frame, Fig. 1, and the flame of the spirit-lamp passed under it, so as to keep up a gentle warmth, by which the spirit is rapidly vaporised, taking especial

care not to bring the flame too near the plate, or the vapour of the spirit may take fire. A few minutes will be sufficient to drive off the spirit, and the plate, when cold, will be found to have a hard and dry coat of varnish, which effectually preserves the collodion film within.*

THE DEVELOPMENT OF A POSITIVE PICTURE.

When a positive picture is required, the time of exposure in the camera should be much less than for a negative or printing picture, since so great a depth of light and shade is not required.

With the exception of a different developing solution, the process is conducted in a manner similar to that given above.

DEVELOPING SOLUTION, NO. 1 (FOR POSITIVE). †

Pyrogallie acid	4 gr.
Distilled water	4 fl. oz.
Acetic acid	30 drops

Dissolve, and add 1 or 2 drops of nitric acid, and filter.

Or, No. 2.

Proto-sulphate of iron	15 gr.
Distilled water	1 fl. oz.
Acetic acid	60 drops
Nitric acid	2 ditto

Dissolve and filter.

No. 2 is perhaps the least difficult to manipulate with, and produces very perfect results.

This is to be used as already described for the negative picture, employing the stand Fig. 1; greater care is, however, necessary, in order to effect the immediate distribution of the solution over the whole surface of the plate. It is better to pour on the solution at the margin of the plate, and then by a slight inclination cause it to flow over the surface, a failure in the even distribution of the solution often occasions great imperfections in the picture. It is advisable not to push the development here to the same extent as for the negative; and accordingly, very

* The process for producing the positive transfers will be described when explaining the practice of Photography on paper.

soon after the picture begins to show itself, the developing solution should be poured off and the picture fixed and washed (as before described) with the hypo-sulphite solution, and afterwards with water.

Positives produced by the bichloride of mercury. (See Appendix.)

The following solution is employed in France for the conversion of a negative collodion into a positive: the picture, having been developed by the proto-sulphate of iron, and thoroughly washed, is plunged into a bath of

Cyanide of potassium	180 gr.
Nitrate of silver	30 gr.
Distilled water	2 pints

It must be afterwards well washed and dried.

PHOTOGRAPHY ON GLASS.

ALBUMENIZED PROCESS.

This process, although extremely useful, is now almost superseded by the more sensitive collodion described above.

Take the clean whites of four fresh eggs, to which add about forty or fifty drops of a saturated solution of the iodide of potassium, or to every 100 grains of white of egg add 1 grain of the iodide of potassium, and about one-third of the whole volume of distilled water. With a clean glass rod or a broadish strip of plate glass* mix these together, or, as it is termed in the culinary art, beat the whole into a froth; then strain it through a clean linen cloth, and allow it to remain quiet for at least eight or ten hours, after which it will be fit for use.

The perfection of these pictures very much depends upon having a layer of albumen of uniform thickness over the surface of the glass plate, which is not very easily obtained without some such contrivance as the following :

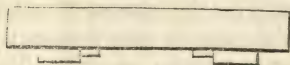
Provide some strips of flatted crown window glass, about one inch broad, and of different lengths, say four, seven, or ten inches.

Let one edge of each be ground flat with some emery and water upon a piece of slate, and then, with a writing diamond, a small file, or the angular point of a piece of flint, mark off upon them the width of the plate to which they are to be applied. Then let the slip of glass be made tolerably hot, and in that state attach to it a little melted sealing wax at the ground edge, allowing it to stand up in a ridge on either side of the lines previously

* A clean silver spoon or fork answers as well for this purpose.

marked upon it, and extending over on the inner side about the eighth of an inch. When the slips are quite cold, let the corresponding glass plate be made moderately warm, but only so warm as to soften, not melt, the sealing-wax on the slip. Now place upon the centre of it a stout piece of card, about a quarter or half an inch less all round than the glass plate, and bring the strip of glass with its sealing-wax edge in a vertical position down upon the warmed plate, holding it by pressure until the wax adapts itself to the thickness of the card; that portion of the wax which extends beyond the plate will thus form a kind of gauge for the latter, while the other portion of the wax, equal in thickness to the card, extends over on either side of the plate about the eighth of an inch in the small plates, and half an inch in those of a larger size, giving a margin of that extent on each side. The slip, when completed, will be of the form Fig. 9.

Fig. 9.



The glass plate must be cleaned with the same precautions as given in the Collodion Process, the margin being roughened as before directed (see Collodion Process).

To coat the plate with a layer of albumen, hold it by the left hand in a horizontal position, and pour upon it a good quantity of the prepared albumen. Incline the plate from one side to another until the albumen has covered the whole surface, then pass the slip of glass, above described, once over the uneven surface of the albumen, the slip as it passes being guided by the gauge points of sealing wax. By this means a uniform layer of albumen will be left on the plate, and the surplus quantity swept off as the gauge passes over. The albumenized surface should now be allowed to dry spontaneously in a place quite free from dust, and when thoroughly dry the

plates are to be exposed to a temperature not higher than 180° Fahrenheit, until every trace of moisture is removed.* This gives a firm and horny character to the surface, which, if preserved from a damp atmosphere, may be retained for any length of time.

To render the plate sensitive to the light make a solution composed of

Crystallized nitrate of silver	70 gr.
Distilled water	1 fl. oz.
Glacial acetic acid	1 drachm

or.

Crystallized nitrate of silver	48 gr.
Distilled water	1½ oz.
Acetic acid	1 drachm

a sufficient quantity of either solution must be employed to fill the glass trough, Fig. 8. (See Collodion Process.) The same precautions being observed in the introduction of the plate, to prevent streaks and irregularities being produced, it is allowed to remain in this bath from three to five minutes. On removal it must be well washed in distilled water by allowing the water to flow freely over it in one direction, and it is now ready for the camera;† or allowed to dry in the dark, in which state it may frequently be preserved for forty-eight hours prior to using it. The time of exposure will vary from three to twenty minutes, according to the nature of the lens and the subject to be copied.

To develop the picture, on its removal from the camera it must be immersed in a bath containing a warm, not hot, solution of gallic acid, to which a little of aceto-nitrate of silver solution has been added, about half a drachm to every two ounces, until fully developed; or the plate may be placed on the frame Fig. 1, and the solution spread over it with a flock of cotton.

It is then fixed with the hypo-sulphite of soda by pouring the solution on the surface of the plate, the latter being placed in the levelling stand, Fig. 1, and finally well

* Many operators recommend a rapid drying by exposure to heat directly, but as this requires extreme care, the preferable mode, where time can be given, is that described above.

† It is of course unnecessary to remark that this part of the process must be carried on in a darkened room.

washed in distilled water, and permitted to dry spontaneously. When perfectly dry the pictures may now be varnished, and are capable of furnishing positive proofs hereafter to be described.

Mr Fox Talbot, some time back, published a process in which the albumenized plate is employed, which, from its highly sensitive character, has been aptly termed the instantaneous process, as a picture was produced by the momentary spark of an electric flash. The process is as follows:

- A. The glass plate being coated with albumen, is then to be dipped into the following solution:

Nitrate of silver 3 gr.
Strong alcohol and water 1 fl. oz.

Well wash the plate in distilled water, and allow it to dry spontaneously.

- B. The plate is now to have a second coating of albumen, which may be dried by a moderate heat, so as not to decompose the nitrate of silver.
- C. Dissolve in 1 ounce of distilled water 140 grains of the protiodide of iron, to which add 1 ounce of acetic acid and 10 ounces of alcohol; this must be allowed to stand for three days before using it; immerse the plate in this solution for a few seconds.
- D. The plate, thus prepared, is next to be dipped, in a darkened room, rapidly once or twice into the following sensitive solution, viz.:

Nitrate of silver 70 gr.
Distilled water 1 oz.
Acetic acid 2 drachms

And afterwards placed in the camera with as little delay as possible.

- E. To develop the picture, the plate when removed from the camera must be dipped into the following mixture:

Saturated solution of the proto-sulphate of iron 1 fl. oz.
Distilled water 3 fl. oz.

- F. The picture is rapidly developed, and must now be fixed with the hypo-sulphite in the usual way.

TALBOTYPE.

DIVISION No. III.

PHOTOGRAPHY ON PAPER.

In this, as in the two former divisions, we shall confine our description to those processes only which, from the success that has attended them, may be regarded as most likely to interest the practical though non-professional operator.

THE PAPER.

Paper is now manufactured expressly for this purpose, and thus, much of the annoyance which attended the operations of the experimentalist in the early stages of this discovery is most fortunately removed. The kind of paper most commonly used is named Turner's, Whatman's, and Canson Frères. It should be uniform in texture and thickness, and free from spots, defects which are readily detected by holding the paper before a strong light prior to cutting it into the required size. The English papers are generally preferred for positive proofs, the French, on the contrary, for negatives. The selected paper may then be cut into pieces adapted to the size of the apparatus at the command of the operator, leaving a margin of about an inch in the direction of the length of the paper.

The first process we shall describe is that given by Mr Fox Talbot, whose name by common consent is given to the paper process generally.

Solution A.—Dissolve 100 grains of pure nitrate of silver (in crystals) in six ounces of distilled water.

Solution B.—Dissolve 500 grains of the iodide of potassium in sixteen ounces of distilled water, and filter it.

Solution C.—Dissolve 100 grains of pure nitrate of silver (in crystals) in two ounces of water, and filter it.

Solution D.—A saturated solution of pyrogallie acid.

Solution E.—Dissolve four ounces of hypo-sulphite of soda in one pint of water.

These solutions must all be prepared beforehand, and those of them containing silver carefully preserved from exposure, even to ordinary day-light.

The apparatus required for preparing the paper consists of at least three flat earthenware pans, Fig. 7, and three or four badger hair brushes, or, what is better, the extemporaneous brush of Mr Buckle. This latter is an extremely useful article, and as it can be prepared at little cost the operator can afford to be rather prodigal in its use.

Take a mass of fine cotton wool, about the size of an egg, and let this be drawn out in the centre, so as to leave the greater portion of the fibres at either end. Then take a tube of glass about six or eight inches long and half an inch in diameter, down the centre of which pass a wire of silver, about half the thickness of a common pin, whose lower end terminates in a hook, to which must be attached the middle of the extended tuft of cotton. Pull the wire (with the cotton attached) into the tube, remove any straggling filaments, and wash it in distilled water, after which it is ready for use. As several tufts of cotton can be kept ready for this purpose the brush may be replenished in a few seconds, which should always be done at every fresh preparation of paper. These, with the addition of two or three quires of white blotting paper, are all that will be necessary. To prepare the paper, place as many sheets as you intend to use, one upon the other, upon three or four doubled sheets of blotting-paper. The sheets to be prepared should have a fold of about one inch in the direction of the length, which serves as a margin to hold the paper in the subsequent operations. It is advisable to put a pencil mark on all the upper surfaces, that the prepared sides may at once be detected.

No. 1.—Take of solution A, and, with the cotton brush,

wash over the upper surface of each piece of paper as they lie one upon the other,* then let each piece of paper, as it receives its layer of the solution, be hung upon a line at a little distance from a fire, that it may become well dried.

No. 2.—A sheet of paper, as above prepared, is then to be placed with the prepared side downwards, so as to float it on solution B, previously poured into one of the earthenware pans, each sheet being allowed to remain so situated for about sixty or eighty seconds and afterwards hung again upon the line until about three-parts dry. If many sheets of paper are to be prepared, the solution will require to be frequently renewed.

No. 3.—The paper, having been thus furnished with a coating of the iodide of silver, and being nearly dry, is to be well washed in water. In preparing many sheets, the operator should be provided with not less than three large pans containing soft, clean water, into the first of which several sheets of prepared paper may be introduced, and permitted to remain for ten or fifteen minutes. Such an arrangement, however, can only be adopted when the vessel is sufficiently capacious, as care must be taken to prevent one sheet from attaching itself to the upper surface of another, and since there is no unnecessary expedition required here, it is better to operate with one sheet at a time. The paper, after being washed as above directed, may now be carefully placed in pan No. 2, and gently drawn through the water two or three times, then once more into No. 3, and afterwards hung up to dry in any convenient position without regard to light, which now no longer influences it.

When dry it may be kept in a folio for any length of time without injury.

TO PREPARE THE PAPER FOR THE CAMERA.

This part of the process must be carried on at the time of using the paper, and in a room lighted only by means

* This should be done by candle-light.

of a candle. Into a graduated glass measure pour equal quantities of solutions C and D, to which may be added about one-sixth of the volume of glacial acetic acid. No more of this composition should be made than is requisite for the one piece of paper, as it is very rapidly decomposed. The most convenient, and at the same time the most economical, mode of applying this solution is as follows:

Procure a slab of plate glass, or one of the white tiles used by the chemists and druggists in mixing up pills and ointments.* This must be a little larger than the sheet of paper, and should be made to present a level surface, which is easily effected by introducing pieces of paper under the corners as occasion may require. Pour upon this slab a sufficient quantity of the above mixture, and with a glass rod diffuse it so much over the surface as will correspond with the size of the sheet of paper. Then, holding the latter by the margin, bring the prepared side down upon the solution on the slab, and with the fingers of the right hand, still holding the margin, press the paper gently in contact with the solution, taking care not to allow any of it to touch the fingers. It frequently happens that a bubble of air becomes enclosed between the paper and the glass, which must be carefully pressed out to the edge, or it will produce a stain upon the paper. As soon as the paper has imbibed the solution (which should be effected in a very few seconds) it must be lifted off by the margin, as it changes most rapidly if permitted to remain longer in contact, and washed in not less than two waters,—all that is necessary is simply to draw the paper two or three times through the water in each of the pans, as before directed. The superfluous moisture should then be quickly drained off, and the paper is now ready for the camera; or the paper may be placed with the prepared side upwards on the slab of glass, then with a glass rod about 10 or 12 inches long, according to the size of the paper, place it at the edge of the uncoated margin of the paper, and let the solution be poured on the paper in

* It should be remembered that every trace of grease and dirt must be carefully guarded against.

a line with the rod of glass; the latter being now moved over the surface of the paper carries with it the solution, which by this means becomes uniformly distributed.

The paper thus prepared is of the utmost degree of sensitiveness, and, from the rapidity with which it undergoes a change, it requires no inconsiderable degree of practice to use it with perfect success.

A less sensitive paper may be prepared, and upon which the young operator should commence, by diluting the mixture C and D with one-half of its volume of distilled water, the manipulatory part of the process being the same as above described. It is scarcely necessary to observe that the prepared paper should be cut to the required size, (if too large for the camera) prior to the application of the last process.

With regard to the time of exposure in the camera, as in all the other processes, no positive directions can be given, as it may vary from ten seconds to as many minutes; experience is the only guide.

DEVELOPING THE PICTURE.

On the removal of the picture from the camera, little or no trace of the effect of the light is visible upon its surface. To bring out the picture it must be subjected to a process similar to that employed in preparing the paper for the camera, using the solutions C and D in equal parts, which in this case should be brushed over the surface with a flat badger-hair brush, or by the glass rod before described.

Too much care cannot be taken to exclude every trace of day-light, and to have the slab and vessels quite clean.

Having given the paper its second application, it is to be placed with the prepared side upwards on a sheet of thin glass. Should it happen, as is sometimes the case, that the picture is slow in developing, a very simple and effectual mode of assisting it is to have in readiness a heated flat iron, over the upturned face of which the paper on the glass plate may then be moved at some little distance, taking care not to hold it so near as to dry the surface before it is fully developed. The heat received

by holding the plate and paper before the steam issuing from any vessel in which water is rapidly boiling is another good mode of assisting the development.

The picture being fully developed, it is now to be drawn several times through a bason of clear and soft water, warm, but not hot, and then allowed to soak in another portion of warm water, for five or ten minutes. It is important to remove as much of the salts of silver, not acted upon by the light, as the water will dissolve out, prior to introducing it into the last or fixing solution; this being done, and the picture finally dried between folds of blotting paper, is ready for the last, or

FIXING PROCESS.

Pour into one of the flat earthenware dishes enough of the solution E, previously made moderately warm, to float the picture, which is now to be placed in it and allowed to soak there for four or five minutes, or until the yellow colour the paper acquired in the previous processes has been completely dissolved out. It should then be removed into a bason holding about half a gallon of soft water, and must be left therein to soak for twenty-four hours, in order to remove the whole of the soluble salts from the paper, without which, on being exposed to the light, a gradual change will take place, frequently ending in a total obliteration. The picture, when thoroughly washed, may be dried by pressing it between folds of blotting-paper, and finally by passing a hot iron over some fresh folds of blotting-paper, within which is the picture. It may then be freely exposed to the light. Should it not be convenient to carry through the last or fixing process at the time of taking the picture, it may simply be washed over with a solution of the bromide of potassium, and then in water, and placed between folds of white blotting paper, until a convenient time offers for fixing it as above directed. It must be remembered, however, that we have here only a negative picture, in which the lights and shades are all reversed as in the negative collodion.

PHOTOGRAPHY ON WAXED PAPER.

LE GRAY'S PROCESS.

Process A.—In this process the operator must be provided with a tin, or (which is better) an old Daguerreotype plate. Place this upon any convenient stand, the height of which, from the table, must be such as to enable the operator to pass to and fro the flame of a spirit lamp for the purpose of heating the plate above. Upon this place a sheet of the paper (the thin French paper is generally preferred for this purpose), cut to the required size, and as before directed marked on one surface. Pass the flame of the spirit lamp underneath the plate, and with a piece of white wax, applied to the upper surface, move the two about until the paper becomes fully saturated with the wax. It is now to be placed between some sheets of white blotting paper, over which must be passed a hot iron for the purpose of removing from the surface of the paper any superfluous wax, the iron being not so hot as to singe the surface of the paper, but sufficiently so to cause the superfluous wax to pass readily into the blotting paper.

TO CHARGE THE PAPER.

Process B.—The first solution necessary for this purpose must be prepared some time before it is required for use, as it not only requires some time to carry it completely through, but also much care and attention, as far as regards the purity of the materials, and the absence of dust and dirt.

To three pints of distilled water add two and a half drachms of isinglass, and three ounces and a half of rice, coarsely bruised but not ground; let this be put into a

clean earthenware jug. The whole must now be placed in a saucepan of water, and allowed to boil for about an hour, when the fluid portion is to be poured off, and strained through a clean and fresh lawn sieve. This is called rice water.

<i>Solution B.</i> —Take rice water	2 pints	} See Appendix.
Sugar of milk	1½ oz.	
Cyanuret of potassium . . .	12 gr.	
Fluoride of ditto	7 gr.	
Iodide of ditto	½ oz.	

When these are all dissolved, filter the solution, which is then ready for use, and will keep good for some time. Pour into an earthenware dish as much of the solution B as will serve to cover to the depth of an inch the pieces of paper prepared in process A. These are to be introduced one by one, taking care not to allow any air bubbles to remain between them, and allowed to remain for about an hour, if English paper is employed; the French paper generally requires less time. A tolerably good criterion of the time necessary is presented by the slight violet tint which the paper frequently assumes.* When this is observed invert the sheets, and having provided some pins bent into the form of the letter S, take the papers one by one, and hook them by one corner to a string arranged across the room to dry. It is well, with some absorbent substance, such as a piece of blotting paper, to touch the lower corner, so as to remove the excess of fluid which drains to that point. About twenty or thirty sheets may be thus prepared at a time.

TO GIVE THE SENSITIVE COATING.

Process C.—*Solution C.*—To five ounces of distilled water add 160 grains of nitrate of silver, and when this is dissolved, add 180 of glacial acetic acid; and filter. The whole of this process must be conducted in

* Should the paper employed not have the violet tint, which the French paper generally has, the addition of two or three grains of iodine to the Solution B seldom fails to produce it.

a room from which the daylight has been carefully excluded.

The prepared waxed paper is now to be charged with the above solution, by any of the modes before described; that with the glass rod is perhaps the readiest mode, allowing it to remain until the violet tint has disappeared. When this is observed, the paper must be removed, and well washed in distilled water, allowing it afterwards to remain in fresh distilled water for three or four minutes—if the picture is to be taken immediately; but if not, a longer time will be found necessary. It is then to be dried between folds of white blotting-paper, and is ready for the camera.

If not wanted for immediate use, it is well to give the paper an extra washing or two; if it is then dried between folds of blotting-paper, and carefully preserved in a portfolio, it will retain its sensitiveness for several days—in which state it may be used in the camera. Although not so rapid in its action, it offers much convenience for out-of-door employment.

THE CAMERA.

The time of exposure in the camera generally required for paper prepared as above, will vary from thirty to sixty seconds with a quick lens; but if the sensitive solution (C) contains less of the nitrate of silver, the time may be as many minutes. For views this is not of much consequence, and for travelling is advantageous, as the paper thus prepared will keep good for a much longer period.

THE DEVELOPMENT OF THE PICTURE.

Process D.—*Solution D.*—Pyro-gallic acid 15 gr.
 Distilled water $\frac{1}{2}$ pint
 Solution C 5 drops
 Dissolve and filter.

Pour this solution into one of the flat dishes, and place therein the paper from the camera. The time necessary

to bring the picture fully out will be regulated by the temperature, and the time of exposure in the camera; if the light has produced the full effect, two minutes will generally suffice; but when this is not the case, two, or even three hours may be given. The action is much assisted by previously warming the solution. When fully developed it should be removed, and plunged into a bath of clean water, and with a camel's-hair brush well wash the back of the picture in order to dissolve out all saline matter, which, if permitted to remain, would produce stains, or might eventually destroy the picture; after which pass it through two or three waters, and it is then ready for Process E.

FIXING THE PICTURE.

Solution E.—Hypo-sulphite of soda . . . 1 oz.
 Distilled water. $\frac{1}{2}$ pint
 Dissolve and filter.

Pour into one of the flat dishes enough of the above solution to cover the picture, and allow it to remain until the yellow tint caused by the iodide of silver disappears, when the picture must be quickly washed in several waters, and finally dried between folds of blotting paper.

Prior to fixing the picture, should any spots be observed, they may generally be removed, if caused by the oxide of silver, by simply brushing on it a solution of acetic acid.

The picture being now completed, after some days, when fully dried, it may have its transparency restored by gently warming it before the fire, so as to remelt the wax within the pores of the paper. It is then ready for printing from, as in the case of the negative plate or picture of the collodion and calotype processes.

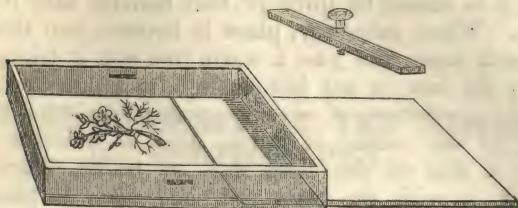
ON PREPARING THE PAPER AND PRINTING POSITIVE PHOTOGRAPHS.

The process sometimes called photogenic drawing exhibits the easiest and the most simple mode of producing

copies of flat objects by light, of any yet described. In its simplest form, it consists of merely washing over the surface of a piece of paper a solution of nitrate of silver of sixty grains to the ounce of distilled water. In preparing paper of this kind, it may be fastened by four pins to a piece of flat board, and washed with one of the cotton brushes before described (or with the glass rod), care being taken, if the brush is employed, not to allow it to pass twice on the same line. The process is best conducted by candle light, and the paper should be hung up to dry in the dark. In copying any flat object, as a leaf, a feather, lace, or a small print, the operator should be provided with two pieces of plate glass, sufficiently large to receive the paper and object to be copied, or, what will answer much better, giving more perfect results with less trouble, is a frame of wood with one plate of glass on which is placed the object and over it the prepared paper, the side on which the solution of silver has been applied being next to the glass. Over this plate three or four pieces of blotting-paper large enough to fill the frame must be placed, and, over all, a back board, to which a thin cushion has been attached, which must be kept tight in the frame by a cross-bar wedging the whole tightly into the frame upon the same principle as the transparent slates used by children.* The frame is then to be exposed to sunlight for a few minutes, or in the absence of the sun a much longer period will be necessary; in fact this paper can only be used with effect during sunshine. In arranging the object to be copied, it will always be advisable to leave a margin of the prepared paper uncovered, by the discoloration of which the operator is enabled to judge of the effect and the necessary time of exposure. When this is completed, it is merely necessary to soak the photograph for some time in warm water in order to wash out the unchanged nitrate of silver, and the process is completed.

* Frames prepared for the purpose may be obtained at the instrument shops. (Fig. 10.)

Fig. 10.



The result now obtained gives only a negative picture, and must itself be made the object to be copied, when we wish to obtain a positive picture in which the lights and shades are properly arranged. For this purpose a much more sensitive paper may be prepared by first charging the sheet with a solution of common salt, or of the hydrochlorate of ammonia (see appendix), in the proportion of four grains to the ounce of distilled water, allowing the first (which may be put on in the day light) to become perfectly dry before the silver solution is applied.

A very admirable paper is prepared by washing over it the following preparation:

Dissolve 30 grains of nitrate of silver in 1 ounce of distilled water, then add, drop by drop, a solution of ammonia until the precipitate is only just re-dissolved; it is better to make only so much as may be required for use at one time.

For obtaining positive transfers from the negative on glass, and the calotype on paper, the following process is probably the best at present known. Take one fluid ounce of the clean white of eggs, and one fluid ounce of distilled water, in which dissolve (before it is mixed with the white of eggs) ten grains of hydro-chlorate of ammonia; mix and beat this up into a froth and then strain it, after which let it stand for ten or twelve hours, as directed for albumenized plates.

Pour some of this mixture into one of the flat earthenware dishes. The paper being folded with a margin (see Calotype) and the one surface marked, the latter is then brought on to the surface of the mixture, taking care to remove all air bubbles, and to prevent the solu-

tion from wetting both sides of the paper. After allowing it to remain for three or four minutes, hang it up to dry. When quite dry, place it between two sheets of smooth paper, and pass a warm iron over it, taking care that the iron is not hot enough to injure the paper. Make a solution of seventy grains of nitrate of silver to one ounce of water, float a sufficient quantity of this on the glass slab, as before directed, or apply it with the glass rod, and upon it place the albumenized side of the paper, allowing it to remain four or five minutes, after which hang it up by one corner to dry. It is then ready for use, as above directed. The transfer having been made, the positive is now to be fixed by the following solution: Dissolve 100 grains of nitrate of silver (the pure crystallized is not necessary here) in a sufficient quantity of distilled water; make a strong solution of common salt in water, and add this a little at a time until it ceases to throw down a white flocculent deposit; then allow the whole to stand until the precipitate formed has settled at the bottom of the glass; pour off the clear fluid, and then expose the solid chloride of silver in the open air to the direct rays of the sun, occasionally stirring it with a glass rod until the whole is changed to a deep brownish black colour. Then dissolve one ounce of hypo-sulphite of soda in five ounces of distilled water, and add to it the black powder above obtained; dissolve, filter, and keep for use.

To fix the proof it must be introduced into a bath of the above solution, and allowed to remain in it at least an hour;* it is then to be washed in several waters, and finally soaked in water for forty-eight hours; afterwards it may be hung up to dry, and on being pressed between paper, as above directed, the picture is finished.

Should only plain or unalbumenised paper have been employed, the glossy appearance due to the former may now be communicated, by washing with a camel's-hair brush a mixture of equal parts of white of egg and distilled water, finally finishing with the warm iron.

* Different shades of colour may be obtained by a longer immersion, at the taste of the operator.

GENERAL SUMMARY OF THE HISTORY OF PHOTOGRAPHY.

FROM THE JOURNAL OF THE PHOTOGRAPHIC
SOCIETY. (No. 2, p. 29.)

SILVER.

Nitrate of	Ritter	1801
— (photographically employed)	Wedgwood and Davy	1802
— with organic matter	J. F. Herschel	1839
— with salts of lead	J. F. Herschel	1839
Chloride of	C. W. Scheele	1777
— (photographically employed)	{ Wedgwood	1802
	{ Talbot	1839
— darkened, and hydriodic salts	Fyfe, Lassaigue	1839
Iodide of (photographically used)	{ Herschel	1840
	{ Ryan	1840
— with ferrocyanate of potash	Hunt	1841
— with gallic acid (Calotype)	Talbot	1841
— with protosulphate of iron		
Ferrottype)	Hunt	1844
— with iodide of iron (Catalyso-		
type)	Woods	1844
Bromide of	Bayard	1840
Fluoride of	Channing	1842
Fluorotype	Hunt	1844
Oxide of	Davy	1803
— with ammonia	Uncertain.	
Phosphate of	Fyfe	1839
Tartrate — Urate — Oxalate — Bo-		
rate, &c.	Herschel	1840
Benzoates of	Hunt	1844
Formiates of	Hunt	1844
Fulminates of	Hunt	1842

SILVER PLATE.

With vapour of iodine (Daguer-		
reotype)	Daguerre	1839
With vapour of bromine	Goddard	1840
With chlorine and iodine	Claudet	1840
With vapour of sulphur	Niepee	1820
With vapour of phosphorus	Niepee	1820

GLASS PLATE.

Precipitates of silver	Herschel	1839
Albumen on	Niepee de St Victor	1848
Collodion	Archer and Fry	1850

GOLD.

Chloride of	{ Rumford	1798
		Herschel 1840
Etherial solution of	Rumford	1798
Etherial solution of, with pereya- nide of potassium	Hunt	1844
Etherial solution of, with proto- cyanide of potassium	Hunt	1844
Chromate of	Hunt	1844
Plate of gold and iodine vapour	Goddard	1842

PLATINUM.

Chloride of	Herschel	1840
— in aether	Herschel	1840
— with lime	Herschel	1832
Iodide of	Herschel	1840
Bromide of	Hunt	1844
Percyanate of	Hunt	1844

MERCURY.

Protoxide of	Uncertain.	
Peroxide of	Guibourt.	
Carbonate of	Hunt	1844
Chromate of	Hunt	1843
Deutiodide of	Hunt	1843
Nitrate of	Herschel	1840
Protonitrate of	Herschel	1840
Chloride of	Boullay	1803
Bichloride of	Vogel	1806

IRON.

Protosulphate of	Hunt	1844
Persulphate of	Herschel	1840
Ammonio-citrate of	Herschel	1840
Tartrate of	Herschel	1840

Attention was first called to the
very peculiar changes produced

in the iron salts in general, by

Cyanic compounds of (Prussian blue)	Herschel	1845
	Scheele	1786
	Desmortiers	1801

Ferrocyanates of	Fischer	1795
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Iodide of	Hunt	1844
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Oxalate of	Hunt	1844
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Chromate of	Hunt	1844
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Several of the above combined with

mercury	Herschel	1843
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COPPER.

Chromate of (Chromatype)	Hunt	1843
— dissolved in ammonia	"	1844
Sulphate of	"	1844
Carbonate of	"	1844
Iodide of	"	1844
Copper-plate iodized	Talbot	1841

MANGANESE.

Permanganate of potash	Frommherz	1824
Deutoxide and cyanate of potassium	Hunt	1844
Muriate of	Hunt	1844

LEAD.

Oxide of (the puce-coloured)	Davy	1802
Red lead and cyanide of potassium	Hunt	1844
Acetate of lead	Hunt	1844

NICKEL.

Nitrate of	} Hunt	1844
— with ferropussiates		
Iodide of		

TIN.

Purple of Cassius	Uncertain.
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COBALT

Arsenic sulphuret of	Hunt	1844
Salts of Antimony	Sage	1802
Salts of Bismuth	Hunt	1844
Salts of Cadmium	Hunt	1844
Salts of Rhodium	Hunt	1844

CHROMIUM.

Bichromate of potash	Mungo Ponton	1838
— with iodide of starch	E. Becquerel	1840
Metallic chromates (Chromatype)	Hunt	1843
CHLORINE and HYDROGEN	Gay-Lussac and Thénard	1809
Chlorine (tithonized)	Draper	1842
— and æther	Cahours	1810

GLASS.

Manganese, reddened	Faraday	1823
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CYANOGEN.

Solution of	Pelouse and Richardson	1838
Methyle compounds	Cahours	1846
Crystallization of salts influenced by light	{ Petit Chaptal Dizé	1722
		1788
		1789

Phosphorus	{ Schulze	1727
— in nitrogen	{ Ritter	1801
— and ammonia	Beckman	1800
Nitric acid decomposed by light	Vogel	1806
Fat matter	Scheele	1786
RESINOUS BODIES (<i>Heliography</i>)	Vogel	1806
Asphaltum	Niepce	1814
Resin of oil of lavender	Niepce	1814
Guaiacum	Niepce and Daguerre	1830
Bitumens all decomposed	Wollaston	1803
All residua of essential oils	Daguerre	1839
Flowers, colours of, expressed, and spread upon paper.	Daguerre	1839
Yellow wax bleached	Herschel	1842
Influence of light on electrical phenomena.	Senebier	1791
	E. Becquerel	1839

APPENDIX

ON

THE PREPARATION OF THE CHEMICALS, &c.,
EMPLOYED IN PHOTOGRAPHY.

TABLE OF THE MOST IMPORTANT
ELEMENTARY SUBSTANCES.

Symbol.	Name.	Equivalent.	Symbol.	Name.	Equivalent.
Al	Aluminum	14	Hg	Mercury	100
Sb	Antimony	129	Mo	Molybdenum	46
As	Arsenic	75	Ni	Nickel	29
Ba	Barium	69	N	Nitrogen	14
Bi	Bismuth	213	Os	Osmium	100
B	Boron	11	O	Oxygen	8
Br	Bromine	80	Pd	Palladium	54
Cd	Cadmium	56	P	Phosphorus	32
Ca	Calcium	20	Pt	Platinum	99
C	Carbon	6	K	Potassium	40
Ce	Cerium	47	R	Rhodium	52
Cl	Chlorine	36	Se	Selenium	40
Cr	Chromium	28	Si	Silicium	15
Co	Cobalt	30	Ag	Silver	108
Ta	Columbium, Tantalum	184	Na	Sodium	24
Cu	Copper	32	Sr	Strontium	44
F	Fluorine	19	S	Sulphur	16
G	Glucinum	5	Te	Tellurium	64
An	Gold	197	Th	Thorium	60
H	Hydrogen	1	Sn	Tin	59
I	Iodine	127	Ti	Titanium	24
Ir	Iridium	99	W	Tungsten	96
Fe	Iron	28	U	Uranium	60
La	Lanthanum	47?	V	Vanadium	68
Pb	Lead	104	Y	Yttrium	32
Li	Lithium	7	Zn	Zinc	32
Mg	Magnesium	12	Zr	Zirconium	33
Mn	Manganese	28			

APPENDIX, &c.

1.—ALCOHOL. $C_4 H_6 O_2 = 46$.

This well-known fluid contains (as it is met with in commerce) variable proportions of water; that sold under the name of rectified spirits of wine should have a specific gravity from 0·840 to 0·850, containing, in that case, from seventy-nine to eighty-three per cent. of pure or anhydrous alcohol. The latter, that is, alcohol perfectly free from water, should have a specific gravity of ·794, and boils at 173° Fahrenheit. It is composed of, in the symbolical language of chemistry, $C_4 H_6 O_2$, i.e. four equivalents of carbon, six of hydrogen, and two of oxygen. The excise proof spirit has a specific gravity of 0·9198 at 60°, and contains only 49½ per cent. by weight of absolute spirit.

2.—AMBER VARNISH.

A very excellent varnish for coating the negative glass picture, prior to printing the positives, is made by dissolving powdered amber in chloroform. After a few days a perfect solution will be effected, when it may be poured off into a clean bottle and kept ready for use.

3.—AMMONIUM. $N H_4 = 18$.

When an amalgam of mercury and potassium is thrown into a moderately hot and strong solution of hydro-chlorate of ammonia, the mercury rapidly swells out to an enormous bulk compared with its original volume, and the compound thus formed may be removed from the solution and moulded about in the hands for some time until it eventually returns to the fluid state. If a portion of the compound be placed in water, the mercury quickly returns to the liquid state, giving off ammonia and hydrogen.

Without entering into an examination of the highly interesting views entertained by modern chemists in reference to this experi-

ment, we shall merely observe that it has led them to regard ammonium as the basic radical of all the compounds commonly called ammoniacal, and to consider it in the light of a metal hence called ammonium, composed of one equivalent of nitrogen =14 and 4 of hydrogen=4; the combining proportion will therefore be 18.

4.—AMMONIA. $N H_3 = 17$.

In its uncombined state it exists only as a gas. The liquid ammonia of the shops is water holding different proportions of this gas in solution.

In its pure or uncombined condition ammonia is composed of one volume of nitrogen=14, and 3 volumes of hydrogen=3, condensed by combination into 2 volumes. Its combining proportion with other bodies is=17·100 cubic inches, weighing 18·2 grains. In this country, ammonia is obtained principally from the gas liquor resulting from the distillation of coals in the formation of coal gas. It may also be obtained from the hydrochlorate of ammonia (the sal-ammoniac of the shops), which is a chemical compound of the two gases—hydrochloric acid and ammonia; these, by combination, assume the form of a crystallised solid, and may be decomposed by the action of caustic lime, the gas, as it is evolved, being condensed by distilled water.

Liquid ammonia, as this is commonly called, is met with in the shops of the druggist in two states of concentration: the first, or weakest, should have a specific gravity of 0·960, the other, called liquor ammonia fortior, of only 0·882. The former contains nearly ten grains of ammoniacal gas in 90 of water, while the latter should have nearly 400.

5.—ACETIC ACID.

This acid, in an impure state, is the common vinegar; and although a considerable quantity in this country is still manufactured from grain, by far the largest portion is obtained by the distillation of wood in iron retorts, by which an impure acid, called in commerce pyroligneous, is produced. This, when purified and concentrated, is commonly sold under the name of distilled vinegar.

The glacial acetic acid of the Photographer should be the hydrated acetic acid of the chemists, and may be obtained by the following process:

Take two pounds of purified acetate of soda.

„ nine ounces of sulphuric acid.

„ nine ounces of water.

Pulverize the acetate of soda, and introduce it into a large

stopped retort; mix the water and acid by small quantities at a time, which must then be poured upon the acetate of soda and the stopper of the retort closed. Adapt a receiver to the retort, keeping it cool by allowing water to flow over it, while the retort should be covered up with a cloth to confine the heat developed by the mixture. This heat, though at first quite sufficient to carry on the distillation when about the one-eighth part of it has passed off, should be reinforced by additional heat being carefully applied to the retort until the saline matter is in a state of quiet fusion, care being taken not to over-heat the retort, or the acetic acid will be decomposed. The product thus obtained should then be passed into another retort in which has been previously placed some of the black oxide of manganese, and re-distilled at the lowest possible heat. If the product thus obtained be exposed in any convenient closed vessel, such as a stoppered bottle, to the temperature of 32° Fahrenheit, the hydrated acetic acid will crystallize, and the fluid portion being poured off, there remains the glacial acetic acid, as it is called, which, on being removed from the freezing mixture, returns again to the fluid state. To obtain it in a still more highly concentrated condition it may be again crystallized, and the crystals allowed to drain as before.

6.—ACETIC ACID. Ac O_3 , $\text{HO}=60$.

Is composed of a supposed base called acetylene, and oxygen. The former, viz., the acetylene, is regarded as being composed of four equivalents of carbon and three of hydrogen, while the above acid is considered as being composed of one equivalent of acetylene combined with three of oxygen added to one of water. The combination is thus represented: $\text{C}_4 \text{H}_3, \text{O}_3 + \text{HO} = \text{AcO}_3, \text{HO}$. At a temperature below 60° glacial acetic acid is commonly solid. The specific gravity of the liquid is 1.063, and it boils at 248° Fahrenheit.

7.—BARIUM. $\text{Ba} = 68$.

Is the metallic base of the earth commonly called baryta, but as in this condition it is useless to the Photographer we shall pass to some of its compounds.

8.—CHLORIDE OF BARIUM. $\text{Ba Cl.} = 105$.

This salt may readily be obtained by dissolving the native carbonate in dilute hydrochloric acid; the acid solution, when saturated, should be filtered and evaporated until a pellicle

forms upon the surface. On cooling, the crystals will be deposited, which consist of one equivalent of barium=69, and one of chlorine=36, added to two equivalents of water $\text{Ba Cl} + 2\text{H}_2\text{O}$. On fusing these in a covered platina crucible, the two equivalents of water are driven off, leaving the chloride as a greyish mass, consisting of Ba Cl =105; 100 parts of water at 60° dissolve forty-three parts of the salt.

9.—NITRATE OF BARYTA. $\text{Ba O}, \text{NO}_3 = 131$.

Is prepared in the same way, substituting nitric for the hydrochloric acid. Nitrate of baryta crystallizes in octahedrons, having no water of crystallization. It is composed of one equivalent of the oxide of barium and one of nitric acid $\text{Ba O}, \text{NO}_3 = 131$. This salt is employed in producing the proto salts of iron.

10.—BROMINE. $\text{Br} = 80$.

This elementary body is found combined in very small quantities with either potassium, sodium, or magnesium in sea water, or rather in the mother liquor or bittern which remains after the sea salt has been extracted. We may presume that the operator will not care to make the bromine he wants unless he happens to live in the neighbourhood of salt-works, and even in that case the very large quantity of bittern which is required to yield a very little amount of bromine will cost more trouble and labour than the result is worth. Still, as the process is not without interest, and the experimentalist may wish to use it for amusement, we shall give the necessary details. The mother liquor or bittern from the salt-works having been concentrated as much as possible, it must have transmitted through it a current of chlorine gas until the latter ceases to give to the fluid an increased depth of colour, which at first is only a pale straw tinge, but gradually becomes deeper in proportion to the quantity of bromine; then add to it some sulphuric ether, which rises to the surface, taking up with it the liberated bromine. Decant off the ethereal solution, and add a small quantity of caustic potash; bromate of potash and bromide of potassium are thus obtained. Evaporate this to dryness, and then in a porcelain crucible bring the mass to a red heat, by which the oxygen is expelled and bromide of potassium remains. The bromide of potassium is now to be mixed with half its weight of the black oxide of manganese and introduced into a glass retort, to which must be added its own weight of oil of vitriol, previously diluted with half its weight of water.

To the neck of the retort tube lute on a receiver, which should be kept cool by means of ice. On applying at first a

gentle heat the red fumes of bromine are distilled over, and condensed in the cold receiver : by a second distillation, mixing with the bromine thus obtained a little chloride of calcium, the bromine is obtained pure and dry.

Bromine is a deep red fuming liquid, emitting red fumes very similar in appearance to the per-oxide of nitrogen. These fumes the operator should most carefully avoid, as they produce an exceedingly irritating effect upon the mucous membrane of the nose and eyes. The combining proportion of bromine is 78.39, its specific gravity is 2.99, and it boils at 113° Fahrenheit.

As it is very poisonous, it should be used with caution. When employed by the Photographer, a few drops only are added to a much larger quantity of water, or so much as to give to the water the colour of pale sherry.

11.—BROMINE WATER,

As it is frequently called, is simply a very dilute solution of bromine in water. To six or eight ounces of water add about a drachm of bromine, or so much as always to leave a portion of the bromine undissolved, and shake well together; this may be kept as stock liquor; when required for use, add about one part of this to forty of water, or so much as will produce a pale sherry colour, and put it into the accelerating pan; it is advisable to change it for every plate. The transfer of the liquid to and fro is most conveniently managed by the use of the pipette or a glass syringe.

12.—PERCHLORIDE OF BROMINE. $\text{Br Cl}_5 = 260$.

Is recommended by some Photographers as an accelerating mixture, and may be prepared by passing chlorine gas through bromine, contained in a stopped retort, and passing the evolved vapours into a receiver, kept cool by being surrounded with ice.

13.—Another recipe for this mixture is two parts of hydrochloric acid and one of nitric; to this add bromine drop by drop until no more is dissolved; two drachms of this are to be mixed with eight ounces of water.

14.—Chloride of bromine is a reddish yellow fluid, possessing a very disagreeable and penetrating odour; it mixes with water without producing any chemical change, and when used for Photographic purposes no more should be employed than is sufficient to give the water by which it is diluted a light golden colour.

15.—IODIDE OF BROMINE. $\text{Br I} = 207$.

May be formed by adding dry iodine to bromine until the whole of the latter is taken up; the mass is then to be introduced into

a retort, and the reddish fumes, evolved by a gentle heat, should be passed into a cool receiver adapted to the retort. These, as they condense, form arborescent crystals of iodide of bromine. For photographic purposes bromide of iodine is formed by simply dropping crystals of iodine gradually into a phial containing bromine, until they cease to dissolve. It may be used as directed under the article bromine.

16.—BROMIDE OF LIME.

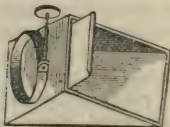
The compound so called is very readily prepared, and takes its rank as one of the best of its class. Place in a stoppered bottle with a wide mouth any convenient quantity, as two or three ounces of recently slaked lime finely powdered and sifted, free from lumps. Introduce into a test-tube about three-quarters of an ounce of bromine, and pass the tube into the powdered lime so that it may stand upright in the bottle, the lime coming within an inch or so of the open end of the bromine tube. Let the stopper be securely attached to the bottle, and stand the whole in water. In the course of forty-eight hours the lime will have absorbed the whole of the bromine and assumed a red colour, deeper or lighter in tone, according to the quantity of the bromine employed.

17.—BROMIDE OF POTASSIUM. $K\ Br=120$.

This has already been described in treating of the mode of obtaining bromine. The formula for its preparation will be given under the head of iodide of potassium, using bromine instead of iodine.

18.—CAMERA. MIRROR.

Fig. 11.



In the ordinary camera the pictures produced upon the prepared surface are always incorrect, the sides being reversed, *i. e.*, the left for the right. In the negative pictures to be printed from this happens most advantageously, as in the transfer the sides, being again reversed, are brought right, but in positives, particularly in views, it forms a serious defect, to remove which a

mirror of silvered glass is used, about four inches long and three broad, or what is much better, one of speculum metal; this being screwed on in front of the lens at an angle of 45° , the camera is then arranged so that the reflected image from the mirror only is transmitted to the lens; by this double reflection, the pictures are produced upon the plate exactly as in nature. It must however be remembered that the two reflections double the time of exposure to the influence of the light.

19.—CHLORINE. $\text{Cl} = 36$.

This element, although not used by the Photographer in an uncombined state, enters nevertheless into several compounds of which considerable use is made, as

Hydrochloric acid.

Chloride of sodium.

Hydrochlorate of ammonia.

Bi-chloride of mercury (see Mercury).

Chloride of gold (see Gold).

Chloride of silver (see Silver).

Chloride of iodine (see Iodine).

Chlorine is readily obtained by placing in a Florence oil flask about one ounce of finely powdered black oxide of manganese, and two ounces of the hydrochloric acid of commerce (muriatic acid). Adapt to the neck of the flask a good cork, to which a bent glass is attached. By a moderate heat the gas is evolved, and being heavier than the atmosphere, by bringing the tube from the flask in which it is generated to the bottom of a bottle, the common air is displaced, which may be distinctly seen by the yellowish green colour of the gas. If the chlorine is not required for immediate use, it should be preserved in a well-stoppered bottle, whose stopper has been greased prior to its being fitted to the bottle.

At all ordinary temperatures chlorine exists as a gas having a greenish colour, whence its name; its combining proportion is 36; its specific gravity being 2.500.

It is indispensably necessary to remember that this gas cannot, even when much diluted, be received into the lungs without producing very considerable irritation; it is therefore best at all times to carry on its manufacture in the open air, taking care to stand on the opposite side to that on which the escaping gas is drifted.

20.—HYDROCHLORIC ACID. $\text{HCl} = 37$

Is the muriatic acid of the old nomenclature, and the spirits of salt of the shops. The commercial acid is frequently contami-

nated with iron, sulphuric acid, &c. To obtain pure hydrochloric acid, introduce into a Florence flask one ounce and a half of common salt, and pour upon that three quarters of an ounce of oil of vitriol previously diluted with an equal weight of water; adapt to the neck of the flask a good cork, to which attach a bent glass tube,* and allow this to dip into a second bottle from which another tube passes into a bottle containing about one ounce of distilled water. On applying a gentle heat the hydrochloric acid gas is evolved, and any fluid matter that may pass in with it is arrested in the first bottle, while the gas passes over into the second, where it is readily condensed by the water. When no more gas passes over the flame should be withdrawn, and nearly pure Hydrochloric acid exists in the second bottle. * Hydrochloric acid is composed of one equivalent of hydrogen combined with one of chlorine. Its combining proportion is 37.

21.—CHLORIDE OF SODIUM. $\text{Na Cl} = 60$.

This compound may be obtained sufficiently pure for all purposes of photography, by dissolving and filtering the bay salt of the shops in water, evaporating it until a strong pellicle forms upon the surface, and then setting it aside to crystallize. Remove the crystals and place them in a funnel, allowing the mother liquor to drain from them.

Chloride of sodium is a compound of one equivalent of the metal sodium=24, and one of chlorine=36, its combining proportion being 60.

22.—HYDROCHLORATE OF AMMONIA. $\text{NH}_4 \text{Cl}$ or $\text{NH}_3 \text{H Cl} = 54$.

Chloride of ammonium, or muriate of ammonia, is the sal ammoniac of the shops, and is found in abundance in some volcanic countries. It may also be obtained during the destructive distillation of refuse animal matter, but it is from the ammoniacal liquor of gas works that the home consumption is now nearly all supplied. It may be obtained sufficiently pure by dissolving and recrystallizing the commercial sal ammoniac. It is composed of one equivalent of ammonia=17, and one of hydro-chloric acid=37; its combining proportion is consequently 54.

* It will be necessary in all such cases, when corks are attached to distilling apparatus, to surround the cork and tube attached with some kind of lute. Linseed meal, worked up into a stiff dough with water, will answer in most cases.

23.—COLLODION.

Is the name given to a solution of gun-cotton in sulphuric ether, which, in its application to Photography by Messrs Archer and Fry, has given rise to one of the most scientific processes of the art, at the same time equalling in beauty and fidelity those of Daguerre and Talbot.

In preparing collodion the first and most important step is that of preparing good gun-cotton. There are three or four different modes employed in the preparation of this substance; it is, however, unnecessary to attend to more than two, which the writer's experience enables him to recommend as the best, and with common caution seldom fail to produce very good cotton. The cotton should be of the finest description, free from dirt and grease, and well carded.

PROCESS I.

24.—Put into a large tumbler half a fluid ounce of strong nitric acid, specific gravity 1.50, and add to it half an ounce of oil of vitriol. Weigh out thirty grains of the cotton, and with two glass rods stir it well into the acid, so that the cotton may become quickly saturated. From fifteen to twenty seconds is generally quite long enough; if a longer period is given the cotton frequently assumes a gummy appearance, which renders it quite unfit for the purpose intended. When the cotton is fully saturated it is removed by the glass rods and plunged into a bason full of cold water, placed under a running tap, the cotton being well worked about so as effectually to wash out every trace of acid, which may be ascertained by applying a piece of blue litmus paper from time to time to the cotton. Should the blue of the paper not be changed, the cotton may be removed from the bason, and the water wrung from it by pressure in a clean cloth, and afterwards between some white blotting-paper. It may then be hung up to dry.

PROCESS II.

25.—To two ounces of coarsely-powdered dry nitrate of potass (saltpetre), placed in a Wedgwood mortar, add four ounces by weight of oil of vitriol. To this add with the glass rods thirty grains of cotton,* stir it well about for two or three minutes, and then wash it as before directed. Both operations should be performed in the open air, in order to get rid of the fumes produced.

* Paper made from linen rags is employed by some Photographers instead of cotton.

26.—COLLODION.

Take nine fluid ounces of rectified ether, and fifteen grains of the dry gun cotton. The latter, if properly prepared, will dissolve readily; then add one ounce of alcohol, cork the bottle tightly, and allow it to stand until any flocculent matter is settled down. It should then be decanted into a stoppered bottle for use.

27.—PREPARED COLLODION.

Into a two-ounce stoppered bottle put one ounce of alcohol; add to this half an ounce of iodide of potassium, and allow it to stand for some days, occasionally agitating the mixture. This will afford a saturated solution of the salt in alcohol. Pour the fluid into another stoppered bottle, and add as much iodide of silver as it will take up; any excess may be left in the bottle for future use. It will be necessary to allow the iodide of silver to remain in the iodide of potassium solution for some hours, with occasional agitation. When fully saturated, allow it to stand until it is quite clear, and then decant it into a third bottle for use.

28.—TO IODIZE THE COLLODION.

Take of the above mixture ten drops, which add to every half ounce of the collodion.

CORROSIVE SUBLIMATE (see Mercury).

CYANURET OF POTASSIUM (see Potassium).

FLUORIDE OF POTASSIUM (see Potassium).

29.—ETHER. $C_4H_{10}O = 37$

Is now regarded as being an anhydrous oxide of a supposed base to which the name of ethyle has been given, and which is composed of four equivalents of carbon and five of hydrogen, while ether, the anhydrous oxide, contains one equivalent of oxygen in addition; hence its composition is $C_4H_{10}O$. The ether sold in the shops is very commonly called sulphuric, from the circumstance of that acid being in this case employed in its composition. It is difficult to prepare upon the small scale, and if due caution be not employed to confine the vapour, its inflammability renders the process highly dangerous. Ether should have, when pure and free from alcohol and water, a specific gravity 0.720 at 60°. It boils at 76° Fahr.

This compound is now extensively employed in the preparation of collodion.

30.—ENGRAVING PHOTOGRAPHIC PLATES.

Several very ingenious modes have been proposed at different times for etching or biting-in the Daguerreotype plate; among others, those of Professor Groves and M. Fizeau. These have, however, hitherto been regarded as curious rather than useful. While engaged upon the present work, the important process of Mr Fox Talbot has been made public in the pages of the 'Athenæum,' No. 1,331, page 522, from which the following process of etching Photographs on steel plates is taken. Although at present in its infancy, we are inclined to consider that if a more sensitive compound could be employed, its importance for microscopic illustrations cannot be too highly estimated. The first thing to be done is to select a good steel plate, and to immerse it for a minute or two in a vessel containing vinegar mixed with a little sulphuric acid. The object of this is to diminish the too great polish of the surface, for otherwise the Photographic preparation would not adhere well to the surface of the steel, but would peel off. The plate is then to be well washed and dried. Then, take some isinglass and dissolve it in hot water. The solution should be strong enough to coagulate when cold into a firm jelly. This solution of isinglass, or gelatine, should be strained while hot, through a linen cloth, to purify it. To this must be added about half as much of a saturated solution of bichromate of potash in water, and they should be well stirred together. When cold, this mixture coagulates into a jelly, which has very much the appearance of orange jelly. The method of using it is to liquefy it by gentle heat, and to pour a quantity upon the centre of the steel plate. Then take a glass rod, hold it horizontally, and spread the liquid uniformly over the plate. Then incline the plate, and pour off the superfluous gelatine. Let the steel plate be placed upon a stand, and kept quite horizontal, that the liquid may not run to one side of the plate. Then place a spirit lamp beneath the plate, and warm it gently till the gelatine is quite dried up. When dry, the film of gelatine ought to be bright yellow, and very uniform. If clouded bands appear upon the surface, it is a sign that there is too little gelatine in proportion to the bichromate, which must therefore be corrected. The steel plate, now coated with gelatine, is ready to receive a Photographic image of any object. First, let us suppose the object is one capable of being applied closely to the surface of the plate; for instance, let it be a piece of black lace, or the leaf of a plant. Place the object upon the plate in a Photographic copying frame, and screw them into close contact. Place this frame in the direct light of the sun for some time, varying from half a minute to five minutes. Let it then be removed, and the plate taken out, and it will be

found impressed with a yellow image of the object upon a ground of a brown colour, as might be expected from the well-known Photographic property of the bichromate. The plate is then to be placed in a vessel of cold water for a minute or two, which dissolves out all the bichromate, and most of the gelatine also, from the Photographic image, *i. e.* from those parts of the plate which have not been exposed to the sun, being protected by the object; while, on the contrary, it dissolves little or none of the gelatine film which has been fully exposed to the sun's rays. The consequence of which is, that instead of a yellow image, we have now a white one, but still upon a ground of brown. The plate is then removed from the water into a vessel of alcohol for a minute, and it is then taken out and placed uprightly on its edge in a warm place, where, in the course of a few minutes, it becomes entirely dried. This terminates the Photographic part of the operation.

If the plate is carefully examined while in this state, it appears coated with gelatine of a yellowish brown colour, and impressed with a white Photographic image, which is often eminently beautiful, owing to the circumstance of its being raised above the level of the plate by the action of the water. Thus, for instance, the image of a piece of black lace looks like a real piece of very delicate white lace of similar pattern, closely adhering to, but plainly raised above, the brown and polished surface of the plate, which serves to display it very beautifully. At other times the white image of an object offers a varying display of light when examined by the light of a single candle, which indicates a peculiar molecular arrangement in the particles of gelatine.

These Photographic images are often so beautiful that the operator feels almost reluctant to destroy them by continuing the process for engraving the plate.

In order to explain how such an engraving is possible, it is, in the first place, to be observed that the Photographic image differs from the rest of the plate, not only in colour, but what is of much more importance, in the thickness of the film of gelatine which covers it.

The coating of gelatine on the rest of the plate is, comparatively speaking, a thick one; but that which originally covered the image has been mostly removed by the action of the water, a small portion, however, almost always remaining. It, therefore, naturally happens that when an etching liquid is poured on to the plate, it first penetrates through the thin gelatine covering the image, and etches the steel plate beneath. But the next moment it penetrates likewise through the thicker coating of gelatine, and thus spoils the result by etching the whole of the plate. Nitric acid, for instance, does this, and therefore cannot be employed for the purpose. Since the other chemical liquids,

which are capable of etching steel, have a certain analogy to nitric acid in their corrosive properties, they also, for the most part, are found to fail in the same manner.

This was a difficulty. But after some researches I found a liquid which etches steel perfectly well, and at the same time is free from the inconvenient property of penetrating the gelatine film. This liquid is the bichloride of platina. In order, however, to use it successfully, it must be mixed with a certain quantity of water, neither more nor less (I mean to any material extent), otherwise its action becomes irregular. The best way is to make a perfectly saturated solution, and then to add to it one-fourth of its bulk of water. Then correcting this by a few trials, a solution of proper strength is finally obtained. Supposing, then, that we have prepared such a solution, the operation of etching the plate is performed as follows:—The plate is laid on a table, and a small quantity of the bichloride being poured upon it, it is to be rapidly diffused and spread over the whole plate with a camel-hair brush. Not much liquid is poured on because its opacity would prevent the operator from distinguishing the effect produced by it on the metal. For this reason, it is hardly necessary to make a wall of wax round the plate; that is, if the portions to be etched are confined to the central part of the plate, and do not approach very near to the edge. The effect of the liquid upon the plate is not at first visible, since it disengages no gas; but after the lapse of a minute or two, the white photographic image begins to darken, and soon becomes black in every part. When this change is complete, the image often looks very beautiful, though quite altered from what it was before. The operator should carefully watch the image until he thinks that it is finished, or not likely to be further improved or developed by continuing the process any longer. He then inclines the plate gently, and pours off the liquid by one corner of the plate. The plate is then dried with blotting-paper, and then a stream of salt water, which is better than fresh water for this purpose, is poured over the plate, which removes all traces of the etching liquid. The plate is then rubbed with a wet sponge or linen cloth, which in a short time detaches and removes the film of gelatine, and discloses the etching that has been effected. When the object is not of a nature to be applied directly to the surface of the plate, the most obvious method of proceeding is, of course, to place the prepared plate in the focus of a camera, and to direct the camera to the object. But, in consequence of the low degree of sensitiveness of bichromate of potash, this would take, generally speaking, too long a time to accomplish. The better way in practice, therefore, is, to take a negative photograph of the object on paper with a camera, and from this to obtain a positive copy either on glass or paper, which should be very uniform in texture, and moderately transparent. This positive copy is placed on the plate in a

photographic copying frame, and being placed for a few minutes in the sun, it impresses the plate with a photographic image; which image, etched as above described, and printed off upon paper, will finally give a positive representation of the object. If the object depicted upon the plate by the sun's rays is broad and uniform, for instance, the opaque leaf of a plant, then, of course, the etching is uniform also; when this is printed off, it produces an effect which is not always satisfactory. I will therefore now explain a modification of the process which destroys this uniformity, and which in many cases produces a great improvement in the general effect.

For this purpose I must remark, in the first place, that if a piece of black gauze or crape is the object selected for representation, it produces an engraving of itself which is marvellously accurate. But when two folds of the gauze are laid across each other obliquely, then the resulting engraving requires a lens in order to separate from each other and distinguish clearly the lines belonging to the two portions of the gauze. Now, if this engraving is printed off, the result offers to an eye at a moderate distance, the appearance of an uniform shading. Now, I avail myself of this circumstance to modify my original process as follows:—Suppose the object to be the opaque leaf of a plant, of irregular outline, first, I cover the prepared plate with two oblique folds of black crape or gauze, and place it in the sunshine for two or three minutes. The effect of this is, to cover the plate with a complicated image of lines passing in all directions. Then the leaf is substituted for the crape, and the plate is replaced in the sunshine for two or three minutes more. The leaf being then removed from the plate, it will be seen that the sun has obliterated all the lines that were visible on the parts of the plate exterior to the leaf, converting all those parts to a uniform brown. But the image of the leaf itself is still covered with a network of innumerable lines. Now, let this be etched in the way already described, and let the resulting etching be printed off. The result is an engraving of the leaf which when beheld by the eye at a certain distance appears uniformly shaded, but when examined closely is found to be covered with lines very much resembling those produced by an engraver's tool, so much so that even a practical engraver would probably be deceived by the appearance. This crape arrangement I call a photographic veil:—and as I think it likely that the idea will prove useful, I will make a few more remarks upon it. It is clear that an arrangement composed of two thicknesses of ordinary crape or gauze is but a rude attempt at a photographic veil. To realize the practical utility that may result from this idea, supposing it to be borne out by further experience, it would be proper to fabricate a much finer material, and employ five or six thicknesses of it, or else to cover a sheet of glass in any convenient

manner with an innumerable quantity of fine lines, or else with dots and specks, which must be opaque and distinct from each other. The result of practically employing such a method, supposing always that it answers in practice, as I think it probably will, would be an etching apparently uniform, but really consisting of separate small portions, in consequence of which it would hold the ink much better, and other obvious advantages would also be obtained. Another mode of accomplishing the same objects is to cover the plate originally with an aquatint ground. But then a fresh one would be required for every plate, whereas a single veil would serve for any number of plates in succession. Experience alone can decide between these different methods. When the etching is finished, the plate should be very soon coated with wax to protect it. A few hours' exposure to the atmospheric air rusts and destroys the etchings when newly made, although it does not do so afterwards. The oxidation only attacks the lines of the etching, the rest of the plate sustaining no injury, if the air is tolerably dry.

31.—GALLIC ACID. $C_7 H_3 O_5 = 85$.

This as its name implies is obtained from nut galls, but the process is one that takes several weeks to complete. Take powdered galls and mix them up with water into a paste. Let this be exposed to the influence of the atmosphere at a temperature of 70° to 75° , adding water as the previous supply evaporates. The mass soon becomes covered with mouldiness, and after some weeks' exposure should be placed in a cloth and all the fluid pressed out. That which remains in the cloth must now be boiled for some time in water, and the solution filtered, while still hot, through coarse filtering paper. This, as it cools, will deposit the Gallic acid which on being re-dissolved and boiled with a small quantity of animal charcoal, and again filtered while hot, can be obtained in a state of comparative purity. The composition of dry Gallic acid is commonly represented as $C_7 H_3 O_5$, that is, seven equivalents of carbon $6 \times 7 = 42$. Three of hydrogen $= 3$ and five of oxygen $8 \times 5 = 40$, consequently the combining proportion of Gallic acid is 85. It is not very soluble, for 100 parts of cold water will dissolve only one part of the acid.

32.—PYROGALLIC ACID. $C_6 H_3 O_3 = 63$.

When the above acid is heated in a retort by means of an oil bath maintained at a temperature of 420° , a decomposition takes place, accompanied by the formation of the pyro-gallic acid

which is sublimed in the neck of the retort, and which was for a long time thought to be identical with the gallic.

It is now proved that although composed of the same elements, yet, being combined in different proportions, a new acid, different from the former, is obtained, which is much more soluble in water than the gallic; an aqueous solution of it is also more readily decomposed than a similar solution of the gallic acid.

A process of preparing pyro-gallic acid different from the above, is the following: Nut galls in powder are to be acted upon by cold water, until the whole of the soluble matter is removed; the solution is then evaporated to dryness; the residue on being pulverized is to be placed in an iron or earthenware pan, two or three inches deep, over which is to be pasted a sheet of filtering paper, like the head of a drum. Let this be pierced full of small holes with a pin, and on it place a light thin glass shade, about a foot high, and large enough to cover over all the holes, or a paper cone may be used instead. The pan is then to be carefully heated, and maintained at a temperature of 400° until no more acid is sublimed through the holes in the paper drum. The sublimed acid may then be removed from the cone or glass.

33.—GOLD, TER-CHLORIDE OF. $\text{Au Cl}_3 = 305$.

This salt is employed in the daguerreotype process for fixing the picture, and in that of the collodion for giving to the positive proofs a black or violet color.

To one part of strong nitric acid add three of strong hydrochloric acid, and stir the mixture until it assumes a deep brown color. Then place the fragments of gold or gold leaf in a Florence flask; on applying a gentle heat the gold rapidly dissolves, when, if necessary, more gold must be added until the acid is fully saturated. Then place the flask in a vessel of boiling water, and keep up the heat until the solution it contains has so far evaporated that the matter becomes solid on cooling; re-dissolve in water, filter, and crystallize by evaporation. The per-chloride of gold, thus obtained, is in the form of deep orange-colored crystals, which should be dried in blotting-paper and preserved in a well-stoppered bottle.

Per or ter-chloride of gold is composed of one equivalent of gold $= 179$ and three equivalents of chlorine 36×3 the combining proportion $= 305$. A solution of one part by weight of crystallized per-chloride of gold to 1000 of water, to which is added twenty-five parts of hydro-chloric acid, has been employed with much success in France, for giving an increase of depth to the lights and shades in the paper process. The pictures are to be immersed in this solution, again well washed in several waters, and finally fixed with the hypo-sulphite of soda.

GOLD-FIXING SOLUTION FOR DAGUERREOTYPES.

Dissolve seven grains of crystallized per-chloride of gold in ten ounces of distilled water and add thirty grains of hypo-sulphite of soda in four ounces of water; mix the solutions and well agitate the mixture. After standing for a few hours it should be filtered, when it is ready for use.

34.—GUM DAMMER.

This gum resin, the produce of the *Pinus dammara*, a native of the East Indies, has been recommended as a good varnish, when dissolved in chloroform, for coating collodion negatives.

35.—GUTTA PERCHA.

This substance has been recommended by Mr Fry as an addition to the prepared collodion, and is certainly, in many respects, a very great improvement, since it produces, when properly employed, a film of greater tenacity than that afforded by the mere collodion. It is said also to increase the sensibility of the plates, a statement however which I think admits of some little doubt. Mr Fry recommends that one part of an ethereal solution of gutta percha should be added to two parts of a thick and fully charged mixture of the prepared collodion, and afterwards diluted by the addition of more ether.

It is to be used in the same manner as already described.

36.—GRAPE SUGAR. $C_{12}H_{14}O_{14} = 198$.

This differs from cane sugar in many important properties. The composition of the latter in its anhydrous state* $C_{12}H_{20}O_{11}$ that is twelve equivalents of carbon, nine of hydrogen, and nine of oxygen, while that of grape sugar, being $C_{12}H_{14}O_{14}$ contains twelve of carbon, fourteen of hydrogen, and fourteen of oxygen. The presence of grape sugar is the cause of the sweetness of most of the ripe fruits, and more especially of grapes (as the name indicates), the juice of which frequently contains from thirty to forty per cent.

The grape sugar of commerce is manufactured on the large scale from starch (a compound of $C_{12}H_{10}O_{10}$) by long digestion with very dilute oil of vitriol. The following mode, which produces a beautiful grape sugar, has been recently recommended. Boil together, for eight or ten hours, four parts of potatoe starch, two of water, and one of oxalic acid. Pour the fluid into a large vessel, and add to it powdered chalk until the whole of the oxalic

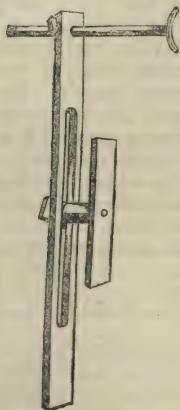
* Free from combined water.

acid is neutralised; let this stand until the insoluble oxalate of lime has subsided, and then pour off and filter the supernatant fluid; let this be evaporated until it assumes the condition of honey, and set it aside to crystallize, then re-dissolve, boil with a little animal charcoal, and re-crystallize.

37.—HEAD-RESTS.

In sitting for portraits very few persons can be found who are able to keep the head rigidly fixed in one position even for a few seconds. In consequence of this, instruments have been constructed called head-rests, to assist the sitter. We here show (Fig. 12) one of the most simple and portable of these, which

Fig. 12.



can be attached to the back of a common chair, and admits of every necessary adjustment. In arranging the figure great care should be taken to avoid putting the head in an unnatural position, which is very commonly the case if the sitter is allowed to adapt his head to the rest, instead of applying the latter merely as a check to any movement.

38.—HYPOSULPHITE OF SODA. $\text{Na O, S}_2 \text{O}_2=80$.

Of the several processes which may be employed in the manufacture of this compound, the following is not only the most simple, but one that affords a very good result. Having mixed

one pound of dry carbonate of soda with ten ounces of sulphur in powder, place the mixture in an evaporating basin, and apply heat sufficient to fuse the sulphur, keeping the mixture well stirred. When the mass has cooled down, dissolve in water and filter. To the clear solution add a fresh quantity of sulphur, and boil down to the point of crystallization; then allow it to stand aside for a few minutes for any insoluble matter to subside, and pour it into a pan to crystallize. Remove the crystals from the mother liquor, and evaporate again for a fresh supply.

The hyposulphite thus obtained should be again dissolved and recrystallized.

Hyposulphite of soda (which is very soluble) is composed of Na O , $\text{S}_2 \text{O}_2$, that is, one equivalent of caustic soda, two of sulphur, and two of oxygen, the combining proportion = 80, added to five equivalents of water in the crystalline state.

39.—IODINE. I = 127.

This element, which is of so much importance to the Photographer, was discovered in 1812 by M. Courtois, of Paris. It is met with in commerce in two states, which are, however, mere modifications of each other. The most common is that of very small metallic-looking scales of a leaden hue, approaching almost to blackness. In the other and purer state (in which only it should be used by the Photographer) it consists frequently of large well-defined crystals of a bright metallic lustre, resembling very much in their appearance plumbago (black lead). Even at ordinary temperatures iodine is very volatile, as shown in the process of iodizing the plate in the Daguerreotype process, but at a temperature a little above 130° it rapidly assumes the state of a deep violet-coloured vapour. It melts at 220° to 225° , boiling at 350° . The specific gravity of iodine is 4.94, and its combining proportion is 127.

The iodine of commerce is not unfrequently adulterated by an admixture of plumbago, and sometimes sulphuret of antimony. If the adulteration should exist it may at once be detected, as pure iodine is wholly soluble in alcohol, while the materials added are not. Iodine has the property of staining the skin with a deep yellow colour approaching to brown, which is, however, easily removed by soap or potash water.

Iodine is obtained from a substance commercially called kelp, an impure carbonate of soda, obtained by burning sea-weed, the manufacture of which is principally confined to the west coast of Ireland and the Western Islands of Scotland. To obtain the iodine, the rough kelp, reduced to a coarse powder, is dissolved in water, evaporated, and set aside to crystallize, whereby the chlorides of sodium and potassium, and several other salts which are less soluble, are removed.

The compounds of iodine, from their greater solubility, remain in the mother liquor, to which oil of vitriol is to be added in small quantities at a time until all effervescence ceases, and the fluid is surcharged with the acid.

After this has been well agitated it is allowed to stand for some hours, and afterwards placed in a leaden retort with a little black oxide of manganese, a glass receiver being attached to the neck of the former; a gentle heat should then be gradually applied to the retort, the iodine is liberated, and passing over in a state of vapour is condensed in the receiver. The crystallized iodine sold by respectable vendors is always sufficiently pure for the purpose of Photography. Where that cannot be obtained the common iodine should be dissolved in alcohol, and the solution filtered; upon the addition of water the iodine is thrown down, and being dried by blotting-paper is in an adequate state of purity.

40.—IODIDE OF POTASSIUM. $KI = 167$.

This compound of iodine and the metal potassium is very commonly called in the shops hydriodate of potassa. It exists in crystals, having frequently a cubic character, and is very soluble in water at the temperature of 65° ; 100 parts of water will take up 143 parts of iodide of potassium.

Of the various modes of preparing this salt I give the preference to that which is detailed below, as it requires a less complicated apparatus, and the manipulation is sufficiently simple even for those unacquainted with chemical processes. To a hot solution of caustic potass add by degrees some iodine, stirring the solution well after each addition. Continue to add the iodine until the solution assumes a brown colour from its excess, then evaporate the solution to dryness, and having broken up the solid mass, bring it to a red heat in a covered iron crucible, adding to it a small quantity of charcoal prior to fusion. The mass when cold and removed from the crucible is to be dissolved with as little water as possible. When filtered and evaporated this may be set aside to crystallize, yielding iodide of potassium, which consists of one equivalent of potassium and one of iodine. Its combining proportion = 167.

Iodide of silver—See Silver.

41.—PROTOSULPHATE OF IRON. $Fe O, SO_3 = 76$.

This compound is now employed for producing positives (see collodion process). The protosulphate may readily be obtained free from the persulphate by dissolving small fragments of clean and bright iron in dilute oil of vitriol in a glass flask. When the acid is saturated the solution should be filtered.

and evaporated by a slow heat until a pellicle forms on the surface. On cooling, beautiful crystals of a bright green colour will be produced, forming the proto-sulphate of iron, and must be dried and preserved for use in a well-stoppered bottle, as by exposure to air and moisture they absorb oxygen, passing into the per-sulphate. This change is seen by the crystals assuming a light brown appearance at the edges, which gradually extends over the entire surface, when it is no longer of use to the Photographer. This salt, in its anhydrous state, is composed of one equivalent of iron = 28, combined with one equivalent of oxygen 8, and one equivalent of sulphuric acid = 40. Its combining proportion is 76. The crystals contain five to seven equivalents of water.

42.—PERSULPHATE OF IRON. $\text{Fe}_2\text{O}_3, 3\text{SO}_3 = 200$

Is formed by boiling a solution of the protosulphate of iron with nitric acid; the latter should be added by degrees, when the former is brought to the boiling point, until no more red fumes are formed, and the fluid is no longer blackened by its addition, then evaporate to dryness, to drive off any excess of nitric acid, when the persulphate is left as a brown uncrystallized mass.

43.—PROTONITRATE OF IRON. $\text{Fe O}, \text{NO}_3 = 90.$

This salt has been recommended by some, in preference to the one above, but its proneness to pass into the state of per-nitrate prevents its being crystallised or kept for any length of time; it is therefore much better to prepare it when required, in small quantities, by the following process:—Dissolve in two ounces of distilled water, by the aid of heat, 200 grains of nitrate of baryta, and 200 grains of the proto-sulphate prepared as above in one ounce of water. Let the solution of the baryta be made in well-stoppered bottles capable of holding double the quantity, and add about three-quarters of the proto-sulphate solution: shake the bottle and allow it to stand for a few minutes, when a heavy white powder (sulphate of baryta) is thrown down; continue to add the proto-sulphate until it ceases to form a precipitate; when the fluid has become clear, pour it into a clean stoppered bottle for use. The solution is the proto-nitrate of iron, of the strength which is generally used. The composition of this salt is one equivalent of the protoxide of iron = 36, and one equivalent of nitric acid = 54; the combining proportion is 90.

44.—IRON, PROTOIODIDE OF. $\text{Fe I} = 155.$

This compound is readily prepared by mixing together in a

Florence flask equal parts of clean iron filings and iodine, together with ten or fifteen times their weight of water. The flask should then be heated in a water bath. The fluid, which at first is of a deep brown colour from the presence of the iodine, eventually changes to that of a light green. When this change is produced the fluid may be filtered and again submitted to the heat of a waterbath until it is evaporated to dryness.* Break it up into fragments and preserve it in a well-stoppered bottle. It is composed of one equivalent of iron and one of iodine = 155.

45.—CATALYSOTYPE

Is the name given to a photographic process in which the above salt is employed in the state of syrup. Take of syrup of iodide of iron two drachms, of distilled water the same quantity, and of tincture of iodine ten drops. Wash the paper with this solution and dry it between blotting-paper; when required for use, wash it over with nitrate of silver solution, of sixty grains to the ounce. The paper when removed from the camera, in which it seldom requires more than from ten to twenty seconds exposure, ought not to show any trace of the picture, but if left in the dark the development gradually and spontaneously takes place. It may then be rinsed in water and fixed in a solution of iodide of potassium, five grains to the ounce, and afterwards washed and dried.

46.—MERCURY. Hg = 100.

This metal, when used for photographic purposes, should always be obtained quite pure, for if this is not the case a good deal of annoyance is sometimes produced from the difficulty of knowing where the error lies.

In the daguerreotype, for example, the repeated warmings the mercury undergoes speedily reduces the metals with which it is adulterated to the state of oxide, and this, coating the surface of the mercury in the box, greatly hinders the due action of the ascending vapours. It is advisable, when the position of the thermometer will admit of it, to enclose it with the mercury in a fine lawn bag, taking care that there is a sufficient quantity of the former to touch the iron pan through which the heat is transmitted; this tends very much to cause an equal diffusion. When pure mercury cannot be obtained, and the impurity is not very considerable, it may in some degree be removed by pressing the mercury through the pores of a clean piece of chamois leather.

* The iron should always be in excess. A very convenient expedient is to introduce a spiral of iron wire into the solution during evaporation.

To obtain the mercury positively pure, it should be dissolved in dilute nitric acid,* and some slips of clean copper introduced into the solution. The affinity of the acid for the copper causes it to combine with the latter in preference to the mercury, which will be found at the bottom of the vessel in a pure state. The blue coloured fluid (nitrate of copper) may now be poured off, and the mercury well washed by shaking repeatedly in vessels of water, its surface being dried by means of white blotting-paper; it should then be poured into well-corked vessels.

47.—CHLORIDE OF MERCURY. $\text{Hg Cl} = 137$.

Mercury, chloride of (corrosive sublimate). This salt is employed for changing negative collodion pictures to positives by what has been called the whitening process. Chloride of mercury is obtained by subliming in an appropriate vessel a mixture of sulphate of mercury and chloride of sodium, by which the bichloride formed is vaporized and condensed. It is commonly met with in the form of imperfectly crystallized masses having a semi-transparency. It is sparingly soluble in water, sixteen parts of which at 60° dissolves one of the salt. Chloride of mercury is composed of one equivalent of the metal and one of chlorine, and is therefore simply a chloride, and not as it is generally called a bi-chloride. Its combining proportion is = 137.

The chloride of mercury is employed in producing on the collodion plates a process that from the nature of the effect is called whitening, which is as follows:

After the plate has been thoroughly washed and fixed, a saturated solution of this salt in hydro-chloric acid, diluted with six parts of water, is to be poured evenly over the surface of the negative picture, the lights and shades of which are by this means reversed, converting the negative to the condition of a positive picture, which on being well washed and dried, is now completed.

48.—NITRIC ACID. $\text{NO}_5 = 54$.

This acid, so important to the Photographer, exists in commerce in various states of purity, under the name of aqua-fortis. It is obtained by the decomposition of nitrate of potass or soda. The manufacture of this acid may be carried on upon a small scale by introducing into a retort equal weights of powdered saltpetre and oil of vitriol, and applying to it the heat of a good argand lamp. To the end of the retort should be applied a Florence flask to

* The process of solution should be conducted so that the fumes may be readily carried away up a chimney or in the open air.

receive the acid as it distils over. Nitric acid thus obtained has generally a specific gravity of 1.5. It is composed of one equivalent of nitrogen, and five of oxygen; its combining proportion = 54.

For Photographic purposes it is of some importance that this acid should be pure. The common sources of adulteration are muriatic and sulphuric acids, and nitrate of potash. The first is detected by diluting a portion of the acid, and adding to it nitrate of silver, upon which a white insoluble precipitate falls, viz. the chloride of silver. The presence of sulphuric acid is also ascertained by adding to the dilute acid nitrate of baryta, when insoluble sulphate of baryta is thrown down. Should it be contaminated with nitrate of potash (which is not unfrequently done to increase the specific gravity), it may be detected by evaporating a portion of the acid to dryness, whereby the white saline nitrate will be left in the vessel.

49.—NITRATE OF LEAD. $\text{PbO}, \text{NO}_3 = 166$

Is obtained by dissolving lead in nitric acid diluted with twice its volume of water; the solution should be assisted by a moderate application of heat to evaporate, and set aside to crystallize. The crystals are anhydrous, and composed of one equivalent of the oxide of lead, and one equivalent of nitric acid; the combining proportion = 166.

This salt has been recently recommended, in the preparation of the protonitrate of iron, as a developing mixture for the collodion pictures on glass; the following formulary has been given: Protosulphate of iron, twelve grains; nitrate of lead, eight grains; water, ten drachms; acetic acid, a half drachm. The sulphate being dissolved, add the salt of lead in powder, and then the acetic acid; shake them well together to effect the decomposition of the sulphate of iron, and filter for use. This developing solution will, it is said, keep good for a considerable time.

50.—PAPER—ALBUMENIZED FOR NEGATIVES.

The following mixture is one sometimes employed in preparing the albumenized paper for negative pictures. Iodide of potassium, fifty-six grains; bromide of potassium, fifteen grains; chloride of sodium, four grains. Dissolve these in two and a half fluid ounces of the white of eggs, prepared as directed under the article albumenized paper.

51.—PAPER FOR PHOTOGRAPHY.

The price given for the paper for photographic purposes is of little moment compared with the annoyance resulting from the use of that which is bad, however cheap it may be, as well as the impossibility of producing good pictures with it. The paper manufactured in France expressly for this purpose is very generally preferred; that of Canson Frères, as also that of Lacroix, are unquestionably first-rate papers. Of those manufactured in England for Photography are Whatmans', Turner and Sandfords', positive and negative papers.

The difference between the French and English paper is said to be principally due to the sise employed in its manufacture; the foreign manufacturers using starch, while the English employ sise. The use of the latter substance, when prepared from animal matter, is by no means objectionable, but in a very large quantity of paper made in this country the glaze is produced by a resinous compound. Common English writing-paper is also frequently mixed up with plaster of Paris, or a fine white clay, both of which are highly objectionable from their reaction upon the sensitive compounds. The paper also should be free from spots, and without the water-mark.

52.—PHOTOGRAPHY ON WOOD, METAL, AND OTHER SURFACES.

The surface on which the picture is to be produced, if metallic, as steel or copper, must be coated on both sides with the varnish used by the engraver as his etching ground, which must be applied to it in the same way. When the varnish is quite hard and dry, the plate is then charged with a film of collodion in the usual manner (see Collodion Process), and subsequently treated as a collodion picture, except that a bath of cyanide of potassium is substituted for that of the hyposulphite in the fixing process. The plate is then to be well washed in water, and afterwards dipped in a solution of dextrine* and dried.

Card board, blocks of wood for the engraver, and other absorbent bodies, after being well coated in every part with varnish, taking care to apply it so as to preserve a smooth surface, may be treated in the same manner. The pictures thus formed on wood and metallic plates are intended to serve as the outline for the subsequent operations of the engraver.

53.—TALC.

This mineral substance has been recommended as a substitute for glass in the collodion process, and if found successful seems

* British gum.

to offer many points of advantage over the latter. Having procured a sheet of talc cut to the required size and about one sixteenth of an inch in thickness, the picture when produced may, by a lancet, be split off from the body beneath, leaving a chemically clean surface ready for another. As the film of talc so removed need not be thicker than a sheet of the thinnest tissue paper, the Photographer is thus provided with a stock of plates ready for his hand in the best possible condition for use.

54.—PLATES—SILVER TO POLISH.

The process of cleaning and polishing the Daguerreotype plates by the professional Photographer, although similar in principle to that given in the body of the work, is much expedited and more effectually carried out by the use of circular buffs, formed of disks of wood, covered with velvet, made to screw on to the mandril of a lathe, which, being worked by the foot, produces a rapid rotatory motion of the buff; the plate, held either by the fingers, or placed in a holder, is pressed against it. Three buffs are usually employed, viz. :—No. 1 for oil and tripoli, No. 2 for cleaning off the oil preparatory to burning, No. 3 the polishing buff; the final buffing being always given by the hand, as before directed.

55.—POLISHING POWDERS.

The substances commonly employed for polishing the plates in the Daguerreotype process are finely levigated pumice, tripoli, rouge, and prepared lampblack. These may generally be obtained ready prepared from the dealers in Photographic chemicals, and when that is the case, it is useless to take the trouble to prepare them for yourself.

It may happen that the operator cannot procure them in the prepared state, in which case the three first powders are thus obtained :

Let the mass, or powder, in whatever state it may be purchased, be reduced to the finest possible state by long trituration in a mortar, and then sifted through very fine muslin. The fine powder which passes through is then to be mixed with a large quantity of water, and allowed to stand for a short time, until the heavier particles have fallen to the bottom of the vessel; the water, with the finer portion still suspended in it, is then poured off and allowed to settle, and the deposit, when well dried, is fit for use.

In preparing the lampblack, the substance sold under that name in the shops must be made red hot in a covered crucible

for some time, in order to decompose the oleaginous or resinous matter with which it is generally contaminated.

56.—PLATINUM.—BICHLORIDE OF. $\text{Pt Cl}_2 = 171$.

This salt is prepared in the same manner as directed for the chloride of gold, which see.

The Bichloride of platinum, which dissolves readily in water, alcohol, and ether, is composed of one equivalent of platinum, combined with two equivalents of chlorine. Its combining proportion is, therefore, $= 171$.

This salt is employed by Mr Fox Talbot in his new process of engraving steel Photographic plates.

57.—POTASSIUM, IODIDE OF (see Iodine).

58.—POTASSIUM, CYANIDE OF—CYANURET OF.
 $\text{K Cy} = 66$

May be prepared by fusing in a red hot crucible eight parts of ferro-cyanide of potassium (the yellow prussiate of the shops), and three of carbonate of potass. Both salts should be previously well dried in a crucible, reduced to a fine powder, and intimately mixed, occasionally stirring the fused mass, until, upon cooling, a small portion of it is found to have lost its yellow colour. Then remove the crucible from the fire, and pour off the liquid mass upon a piece of tile or slate. When cold and solid, reduce it to fragments, dissolve it in water, filter, and evaporate to dryness. It should be preserved in a well-stoppered bottle.

This process does not yield the cyanide pure, it being mixed with a little of the cyanate of potass. If required of greater purity, the dried mass, when reduced to powder, should be boiled in dilute alcohol, which, on cooling, deposits the cyanide sufficiently pure for all practical purposes.

Cyanide of Potassium is a deadly poison, but little inferior to hydro-cyanic acid (Prussic); it is composed of one equivalent of the metal, and one of cyanogen. The latter is a compound of two equivalents of carbon and one of nitrogen, the symbol for which is Cy. Its combining proportion is 26, consequently, that of cyanide of potassium is $\text{K Cy} = 66$.

The use of compounds of this salt has given the name to a process called Cyanotype, possessing but little general interest.

59.—POTASSIUM, FLUORIDE OF. $\text{KF} = 59$.

This salt is a compound of the uninsulated element fluorine and potassium, and is obtained by saturating hydro-fluoric acid

with potassa, and evaporating the solution to dryness. The hydro-fluoric acid is obtained, with some difficulty, by distilling fluoride of calcium (fluor spar) with thrice its weight of oil of vitriol in leaden vessels, the receiver, also of lead, and well luted, being immersed in powdered salt and ice. It is a highly dangerous and corrosive fluid, and can only be preserved in lead or platina vessels, with accurately-fitted stoppers of the same metal.

Fluoride of potassium is composed of one equivalent of the metal and one of fluorine, its combining proportion = 59.

A Photographic process called the Fluorotype is carried out by dissolving twenty grains of bromide of potassium in one fluid ounce of distilled water, and also five grains of fluoride of potassium in a similar quantity. The solutions are to be kept distinct until wanted, when a small quantity should be mixed together and washed over the paper. The latter, when dry and required for use, should be charged with a nitrate of silver solution of sixty grains to the ounce. The paper, when removed from the camera, should be soaked in water, and afterwards brushed over with a solution of the proto-sulphate of iron.

When the picture is developed it may be washed in the hyposulphite, and afterwards in water.

60.—POTASH, BICHROMATE OF. $\text{KO}, 2\text{Cr O}_3 = 152$.

This salt, which is now extensively employed by the calico-printers, is a compound of chromic acid and oxide of potassium = 152. Paper stained with a solution of this salt is extremely useful in copying leaves and other flat objects. Although far inferior to the silver preparation for sensitiveness, it nevertheless has its advantages from the simplicity of the process. The portion of the paper charged with this salt, when exposed to the light, changes to a brown more or less deep in color according to the quantity of the salt employed, while the covered portion retains the original yellow. To fix this Photograph nothing more is necessary than to steep it well in water until those parts not acted upon by the light are made white by the washing out of the salt. From this negative almost any number of positives may be obtained in the usual way.

This branch of Photography is called the Chromatype.

MICROSCOPIC PHOTOGRAPHY.

61.—The fixing the magnified image of the microscope on the prepared plate is certainly one of the most important applications of this interesting branch of art. To ensure success four things are essentially necessary.

1st. A good achromatic microscope. 2nd. A microscopic camera. 3rd. A highly sensitive plate. 4th and lastly, a good and strong light.

Of the first, it is not our province to enter upon, further than to remark that a bad instrument cannot be made to produce a good picture. Supposing, then, that the operator wishes to adapt his microscope (good or bad as the case may be) for copying the magnified image, the following is the most simple plan for effecting the same.

Remove the lens from the ordinary Photographic camera, and in its place insert the body of the microscope with its appendages, having removed it from its support, so that the eye-piece* takes the place of the lens, which must of course be firmly fixed by any convenient mode in the position here described.

The object in the microscope should first be focused independently of the camera; the latter may then have the ground glass introduced, upon which an enlarged image of the object will be produced, this may then be focused as any other object.

In reference to the third requisite, viz., a highly sensitive plate, the collodion on glass is not only the best but the most useful, inasmuch as we may thus, with the negative picture, produce any reasonable number of positive copies.

The fourth essential, the light: if the direct rays of the sun are employed, no difficulty, as far as regards intensity of action, need be apprehended; but when artificial light is employed, it should be of the strongest character, and as white as possible; the best artificial light is undoubtedly the voltaic, next to that the hydro-oxygen, but in the absence of these a good camphine lamp may be substituted, provided sufficient time be given.

* The part to which the eye of the observer is applied when looking into the instrument.

The preparation and treatment of the prepared plate is the same as that described under the collodion process.

62.—POTASH, NITRATE OF. $\text{KO}, \text{NO}_3 = 102$.

This well-known salt crystallizes in six-sided prisms, and is composed of one equivalent of the oxide of potassium and one of nitric acid = 102.

These crystals, although anhydrous, frequently contain water in the hollows, left by the adhering crystals; nitre, when heated to about 600° , fuses, and, on cooling, assumes a solid semi-opaque appearance, known in commerce as *sal prunelle*.

63.—PRINTING POSITIVE PORTRAITS.

In obtaining positive proofs from the negative pictures, it has been recommended that instead of bringing the negative surface in immediate contact with the prepared positive paper, a sheet of blank writing-paper, free from the water-mark, be interposed between them prior to their being pressed into contact, and in this way exposed to the light. The latter, having to penetrate the double thickness of paper, softens the outline, and thus produces a much more agreeable result.

64.—SILVER. $\text{Ag} = 108$.

This metal is of the utmost importance to the Photographer, from the facility with which many of its compounds are decomposed by the chemical influence of light.

65.—SILVER, NITRATE OF. $\text{AgO}, \text{NO}_3 = 170$

Is obtained by dissolving silver in a mixture of one of nitric acid diluted with three of water. Filter, and evaporate the solution, when the nitrate crystallizes, generally in thin plates, having no water of crystallization. These are composed of one equivalent of oxide of silver and one of nitric acid AgO, NO_3 ; the combining proportion is 170. In the preparation of this salt both the acid and the silver should be pure, for if any hydrochloric acid is present in the nitric it precipitates the silver as an insoluble chloride, and if the silver is alloyed with copper (as all manufactured silver is) the solution assumes a blue colour. When pure silver cannot be obtained, an alloyed silver is employed. The solution containing the cotton and silver should be set aside, and some strips of clean copper placed in it, by means of which the silver will be precipitated as a blackish powder. Throw this into a filter, and

well wash it with water, then re-dissolve it as before directed. Nitrate of silver is made the basis of most of the hair-dyes, and also of marking-ink, owing to its ready decomposition under the influence of light, assisted by the presence of organic matter. The nitrate of silver of the shops, or lunar caustic, should never be employed by the Photographer, unless he is satisfied that it is free from adulteration, which is rarely the case.

Paper washed over with a solution of nitrate of silver (100 grains to the ounce of water), and allowed to dry, may be employed to copy leaves, prints, &c. It requires only to be washed in hot water to fix it.

66.—AMMONIA NITRATE OF SILVER. $\text{Ag O, NO}_3 + 2 \text{NH}_3 = 204.$

This compound is prepared by adding liquid ammonia gradually to a solution of nitrate of silver, by which a dark-coloured precipitate is thrown down, after which continue to add the ammonia drop by drop; the mixture should be stirred at each addition. The excess of ammonia re-dissolves the precipitate, forming the above compound. It is well only to prepare as much as may be required for the occasion, as it is difficult to preserve it for any length of time. Paper washed over with this is much more sensitive than that which is prepared with the simple nitrate, and may be used in the same way, fixing it with a dilute solution of ammonia.

67.—SILVER, IODIDE OF. $\text{Ag I} = 235.$

To a solution of nitrate of silver add by degrees a solution of iodide of potassium; a very delicate primrose yellow precipitate is thrown down. The iodide should be carefully added until it ceases to produce a cloudiness (any excess re-dissolves the precipitate) in the fluid, which should then be allowed to stand until the insoluble matter has subsided. This, when well washed and dried, is the iodide of silver. Iodide of silver thus obtained is soluble in iodide of potassium, and hence a solution of the above is frequently employed instead of charging the paper first with the nitrate of silver, and then with the iodide of potassium, as described in the calotype process. To obtain the above solution, add to a saturated solution of the iodide of potassium as much of the dry iodide of silver as it will dissolve. This solution is to be brushed over the surface of the paper, and when it is nearly dry the paper must be washed in several waters, and finally dried for use.—See Calotype.

The solution of iodide of silver for Photographic purposes above described, should contain about twenty or thirty grains of

the iodide to the fluid ounce of water, to which should be added the iodide of potassium, crystal after crystal, taking care that a perfect solution of the one crystal is effected before another is added. This must be continued until the whole of the iodide of silver is dissolved. It is then to be filtered, and applied to the surface either by a brush, or by floating the paper on the surface of the liquid.

68.—SILVER—CHLORIDE, AND BROMIDE.

Chloride and bromide of silver may be prepared by the same process as that last described, substituting chloride of sodium or bromide of potassium for the iodide. Neither the chloride nor the bromide of silver are applied directly to the paper, but are precipitated on the surface by double decomposition, as in the calotype process described under that head. They are sometimes employed for producing both positives and negatives, but are not alone sufficiently sensitive to act with any great success for Photographic purposes.

69.—SILVER, CHLORIDE OF PAPERS

Are thus prepared. Wash over the surface a solution of sixty grains of chloride of sodium in three ounces of water, place it between blotting-paper, and afterwards dry it. Then brush over it a solution of nitrate of silver (sixty grains to the ounce), and it is ready for use. The Photograph must afterwards be fixed by the hypo-sulphite of soda.

70.—SILVER, BROMIDE OF PAPERS.

The only difference here is that the silver solution may be a little stronger, viz., 100 grains to the ounce of water, or even more, if a very sensitive paper is required. In all these papers careful washing in plenty of water is necessary for the removal of the soluble salt resulting from the decomposition, and which, if permitted to remain, is not only unnecessary, but in most cases destructive.

71.—SILVERING DAGUERREOTYPE PLATES.

The deposition of a film of pure silver on the daguerreotype plate by the electro-plating process is highly recommended by many Photographers as the final step in preparing the plate prior to giving it its sensitive coating; but if the plate is in good order and well prepared, we do not think the advantages (if any)

compensate for the trouble and delay. If, however, the plate is much worn, and the silver on its surface is barely sufficient to cover the copper beneath, then the electro-plating process is most useful, giving to an old and otherwise useless plate all the qualities and conditions of a new one, at least so far as that one operation is concerned, for the film of silver is much too thin to admit of a second cleaning, should the first picture fail.

The process of electro-plating is conducted by transmitting a current of voltaic electricity through a solution of the argenticyanide of potassium, so that the current in its return to the battery shall leave the solution from the surface of the object to be silvered.

72.—SILVERING SOLUTION.

One of the best and most ready modes of preparing this solution is by what is called the battery process, and is as follows.

Dissolve half an ounce of the cyanide of potassium in one pint of water, place this in the glass decomposing trough, to be hereafter described, and introduce into it a flat porous cell, such as are used for Groves' battery; let this be filled with the same solution to within an inch of the top.

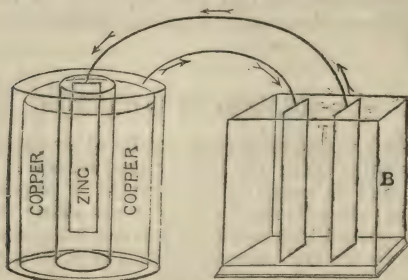
Have ready charged the voltaic battery, and attach by any convenient means (as a binding screw), to the wire passing from the copper of the battery, a thin sheet of silver foil, and to the other wire, viz. that connected with the zinc of the battery, a sheet of copper, of such a size as to fit the porous cell. Then place the silver foil into the cyanide in the glass decomposing trough, and the plate of copper into that of the porous cell. At the expiration of from twenty-four to forty-eight hours (changing occasionally the acid in the battery), the plate of silver will have nearly all disappeared, having been by the action taken into solution. The fluid in the porous cell may now be thrown away, and that in the glass trough, when filtered, is fit for use.

For electro-plating, a common acid battery, as that of Wollaston, or Smee's, is generally employed. If this should not be at hand the following simple arrangement may be employed. Roll up a slip of thin sheet copper, and place it in an earthenware jar capable of holding about a pint and a half (the size of the sheet of copper will be regulated by the size of the jar); to this, by a wedge of wood or a binding screw, attach a copper wire about twelve inches long.* Roll up a corresponding cylinder of thin sheet zinc, to which, as before, a wire of copper has been attached; let the cylinder of zinc be well washed over with a

* Where it is convenient, it is better that the wires should be soldered or attached by metal binding screws.

strong solution of the chloride of mercury (corrosive sublimate, which see), by which a coating of mercury is given to it.* Place the zinc cylinder within that of the copper, and with some pieces of cork prevent the two cylinders from touching each other. If a mixture of one part of sulphuric acid to twenty of water be poured into the jar, we shall find we have a battery capable of depositing the silver on the daguerreotype plate.

Fig. 13.



The accompanying figure explains the necessary arrangement for conducting the process. B is the glass decomposing trough containing the silver solution. The plate to be silvered must be thoroughly cleaned on both sides, and rendered as free from grease as possible, in fact, the plate should be cleaned and polished in every respect for taking a picture, the copper surface being brightened also. Then, by a small cleft piece of hard wood or a small pair of pliers, attach the plate to the zinc wire of the battery, when, in the course of from three to ten minutes, the electric action will have deposited a film of pure silver on the surface of the plate; it is then to be washed in water, dried in a clean wash-leather or by pledgets of cotton, and having received its final buffing, is ready for the sensitive compound.

73.—SULPHURIC ACID. $\text{SO}_2 = 40$.

This well-known acid is a compound of one equivalent of sulphur and three of oxygen. Its combining proportion is 40. The highly concentrated acid of commerce contains in addition one equivalent of water, and is therefore hydrated sulphuric acid = 49, and should have a specific gravity of 1.85. It boils at 620° .

* Amalgamation.

Much of the common oil of vitriol is now manufactured from pyrites, and hence frequently contains arsenic, which should be avoided for photographic purposes. The detection of this, however, is attended with some trouble, and requires a more extended acquaintance with chemical manipulation than is compatible with our limits to describe.

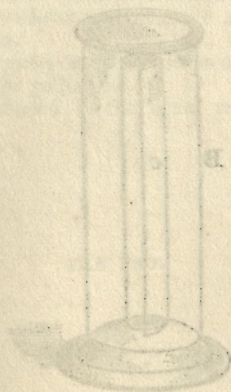
74.—SUCCINIC ACID. $C_4 H_2 O_3 = 50$.

This acid is obtained by dry distillation from amber, or by acting upon stearic acid with hot nitric acid.

In its crystallized state it is a compound of four equivalents of carbon, two of hydrogen, three of oxygen, and one equivalent of water. It is an expensive compound, and is therefore not unfrequently adulterated. The only use made of this acid in Photography is in a process called the

75.—FERROTYPE.

A solution of five grains of this acid, five grains of chloride of sodium in one ounce of water, is to be made, and the paper washed with this and dried, then with a sixty-grain solution of nitrate of silver in one ounce of distilled water, and dried in the dark. This may be used as the ordinary photographic paper, or the latent pictures may be developed by a saturated solution of proto-sulphate of iron mixed with twice or thrice its bulk of mucilage of gum arabic. The picture is washed in water, and then fixed with the hypo-sulphite of soda, and finally washed and dried.



76.—MR STEWART'S PROCESS FOR COPYING VIEWS, &c.

Solution No. 1.—Iodide of potassium, five parts; distilled water 100 parts.

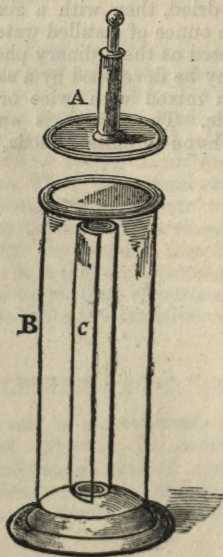
Solution No. 2.—Nitrate of silver (crystallized) fifteen parts; glacial acetic acid, twenty parts; distilled water, 150 parts.

Solution No. 3.—Saturated solution of gallic acid.

Solution No. 4.—Hypo-sulphite of soda, one part; distilled water, six to eight parts.

WET PROCESS.

Fig. 14.



In this the paper is employed in the moist state. Into a shallow dish pour a sufficient quantity of solution No. 1. The paper, being cut to the required size, is to be placed sheet upon sheet in this solution, and the several sheets, while in the fluid, are to be rolled up together into a hollow cylinder C, and introduced into a glass of the form shown in the figure B. The paper is now to be covered with the solution No. 1, more being added if necessary, as it is important that the paper should be entirely covered by the fluid. The brass cap A, with the air syringe attached, is then placed upon the top of the glass, the surface of which must be ground flat; the syringe being put in motion, a vacuum is produced, liberating at the same time the air in the pores of the paper and enabling the solution to enter fully into its texture.

In this state it is allowed to remain for about ten or fifteen minutes, after which it is removed, and each sheet hung up to dry. To prepare this paper for the camera, pour into a shallow dish Solution No. 2, and float a sheet of the above on to the fluid, taking care that none of it touches the upper surface of the paper. In this state allow it to remain for ten minutes, when it is ready for the camera, and requires from ten to twenty minutes' exposure.

To develop the picture, brush over the surface the Solution No. 3.

77.—DRY PROCESS.

The iodized paper, prepared as above, is, in this process, plunged into Solution No. 2, and allowed to soak for five or six minutes, and afterwards washed in water for twenty minutes. It is then taken out without touching the surface, and allowed to dry in a dark room.

To develop these pictures, a few drops of the Solution No. 2 should be added to the gallic acid.

The fixing is conducted in the usual manner with Solution No. 4.

THE END.

In the paper is charged in the most state. Into a shallow dish pour a sufficient quantity of solution No. 1. The paper being cut to the required size is to be placed upon a stand in the solution and the surface of the paper is to be rolled so that it has a hollow cylinder, and introduced into a glass the form shown in the figure. The paper is now to be covered with the solution No. 1. The paper being rolled it is necessary as it is important that the paper should be entirely covered by the fluid. The paper is to be placed upon the stand and a glass placed upon the top of the glass, the surface of which must be ground flat; the surface being in position a vacuum is produced, the air being at the same time the air is the water and causing the solution to enter fully and

is this state it is allowed to remain for about ten or fifteen minutes after which it is removed, and a good deal of the fluid is pressed from the paper for the camera, pour into a shallow dish solution No. 2 and heat a sheet of the above on to the fluid, taking care that none of it touches the upper surface of the paper. In this state allow it to remain for ten minutes, when it is ready for the camera, and replace from ten to twenty minutes.

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THE DRY PROCESS

The iodine paper prepared as above is in this process placed into solution No. 2, and allowed to soak for five or six minutes, and afterwards washed in water for twenty minutes. It is then taken out without touching the surface, and allowed to dry in a dark room.

To develop these pictures a few drops of the Solution No. 3 should be added to the gallic acid. The fixing is conducted in the usual manner with solution No. 4.